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ABSTRACT

This document contains the materials required for presenting an 8-day competency-based technology learning activity (TLA) designed to introduce students in grades 6-10 to advances and career opportunities in the field of laser technology. The guide uses a series of hands-on exploratory experiences into which activities to help students develop basic skills have been incorporated. The document consists of an introductory section, teacher's guide, and student's guide. Presented in the introductory section are an overview of Oklahoma's technology education program and guidelines for using the instructor's and student's guides. The instructor's section contains the following: background information, suggested learning activities, expected learner outcomes, lesson plan, summary worksheet, pretest, posttest, test answers, evaluation summary, and bibliography. The student's guide contains one section for each of the TLA's 8 days. Each section includes some or all of the following: summary of activities and basic skills covered, goal, word list, expected learner outcomes, objectives, academic and workplace applications, information sheets, step-by-step learning activity outline, diagrams, handouts, and career search activity. An optional activity that could be used for solving problems or reinforcing learning is included. (MN)

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ED 380 587

Technology Learning Activity

LASERS

TLA TE-1103

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CIMC

Teacher Edition

Oklahoma Department of
Vocational and Technical Education
1500 West Seventh Avenue
Stillwater, OK 74074-4364

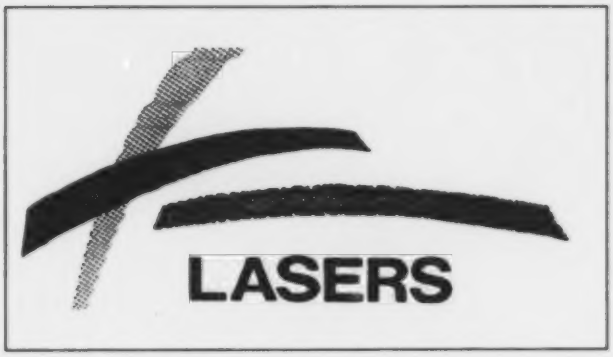
TECHNOLOGY EDUCATION

TECHNOLOGY LEARNING ACTIVITY

TE1103

LASERS

Suggested Time: 8 Days



Developed by the
Curriculum and Instructional Materials Center
for the Technology Education Division
Oklahoma Department of Vocational and Technical Education

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FOREWORD

What will be the careers of the future? The workforce of tomorrow will be shaped by the technologies being developed today. Students today need accurate, interesting information on growing technologies in order to make informed decisions about their futures.

It is our hope that this curriculum will help improve the quality of career decisions for our students. Students are introduced to a wide range of current, "cutting-edge" technologies and are encouraged to think critically about how those technologies influence their lives and futures. Today's students do not have to become the victims of "technological illiteracy," but instead can learn to anticipate technological developments and take positive steps to prepare for the future.

Technology Learning Activities provide students with the knowledge and an introduction to the skills they need for a positive learning and career experience. Every generation is faced with learning how to manage technological advances. Information gained through participation in the *Technology Education* program can help students develop a holistic view of technology on which to base their educational and career decisions.

Roy Peters, Jr., Ed.D., State Director
Oklahoma Department of
Vocational and Technical Education

Roger Stacy, Ed.D., State Supervisor
Technology Education
Oklahoma Department of
Vocational and Technical Education

PREFACE

We believe that one of the most effective ways to improve education is through the development and implementation of a sound instructional materials system. Technology Education instructional materials represent a new design for CIMC which recognizes the importance of graphic materials in the learning process.

Technology Education instructional materials are designed for 6th through 10th grade students. The design of these materials is based on current research on how people read and gain information from documents. The design is called "New Look" and integrates both graphics and text into a balanced presentation which is easy to use and follow.

Technology Education provides the student a look at what the world will be like in the future based on technologies in use and being developed today. Throughout the Technology Education instructional materials, the students are introduced to "cutting-edge" technologies that they will use and encounter in a working environment later in life. This exposure gives them a wide range of experiences on which to base career decisions.

This publication is intended as a starting point, from which the teacher can innovate, localize, and personalize in order to prepare students for their future. The *Technology Education* series of Technology Learning Activities was written with the realization that we are creating the workforce of tomorrow by how and what we teach about technology today.

Sherry Wietelman, Curriculum Development Specialist
Curriculum and Instructional Materials Center
Oklahoma Department of
Vocational and Technical Education

Charles F. Kemnitz, President
Atlatl Communications, Inc.

ACKNOWLEDGEMENTS

The Curriculum and Instructional Materials Center (CIMC) extends its appreciation to those individuals who played important roles in the development of Technology Learning Activity materials.

Generous thanks are extended to Lynn Hawkins and Jim Harder, both Technology Education teachers at Mayfield Junior High School, for the time, talent and knowledge they contributed in determining the content of this Technology Learning Activity (TLA). We also extend our thanks to them for writing the pilot TLA upon which this TLA was based.

Thank you is also extended to the vocational educators who helped with field testing and contributed their expert input on indivdualized vocational instructional methods.

Alan Fillmore
Meeker High School

Jerry Lewis
Atoka High School

Ron Givens
Tulsa-Nimitz Middle School

We also thank the State Director, Dr. Roy Peters, Jr., and the Assistant State Director, Dr. Charles O. Hopkins, for their continued support throughout this project.

The school administrators who supported instructor participation in this project and/or allowed their facilities to be used as field test sites in this project deserve a special thank you, as well.

Chris Gillespie
Atoka high School

Brent Walden
Meeker High School

Marolyn Hunnicutt
Tulsa-Nimitz Middle School

Robert Helsel
Mayfield Junior High School

Oklahoma Department of Vocational and Technical Education Technology Education staff who provided leadership and direction on this project also deserve special recognition.

Roger Stacy, Ed.D.
State Supervisor
Technology Education

Donovan Bowers
Assistant State Supervisor
Technology Education

Harold Holley
Assistant State Supervisor
Technology Education

Special Recognition and gratitude is expressed to Dr. Charles F. Kemnitz who trained and coordinated the efforts of a team of technical writers on this project. His professionalism, dedication and commitment to quality instructional materials allowed us to design learning activities that students can readily use to explore new and existing technologies.

Only through the close cooperation of the Curriculum and Instructional Materials Center staff was this curriculum developed. Sincere thanks are shared with the CIMC coordinators.

Brenda Stacy, Ed.D.
CIMC Coordinator

Lynna Ausburn, Ph.D.
CIMC Development Coordinator

Special recognition and thanks are also extended to other individuals within the Oklahoma Department of Vocational and Technical Education (ODVTE) involved in the development and distribution process: Noel Wilcoxson, Duane "Frosty" Foster and Diane Ensign and their staffs at the ODVTE Print Shop; Bob Davis and staff artist Kathryn Moore for the cover design; Darrel Stiles and his staff in the ODVTE Warehouse for packaging and coordinating transportation and distribution of these materials.

Finally, a big thank you to all ODVTE team members who offer their support on a daily basis in "behind-the-scenes" ways but never seem to be recognized for their contributions: Barbara Keuhl, former CIMC secretary; Suzanne Perry and Terri Tomson, CIMC secretaries; Karen Heppel and Debbie Hixson, Technology Education secretaries.

Sherry Wietelman
Curriculum Development Specialist
Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and Technical Education

TECHNOLOGY EDUCATION OVERVIEW

About the Program

Because the American culture is distinctly characterized as technological, it becomes the function of our schools to give every student an insight into and an understanding of the technological nature of the culture. Technology Education strives to perform this function.

Technology Education in Oklahoma is an instructional program that provides young men and women (grades 6 - 10) with daily, hands-on exploratory experiences and insights into technology and career opportunities so that they can make meaningful occupational and educational choices. It is a program which can enhance the educational experience of all students, whether they are the valedictorian/honor-type student, the middle range/average student, or the student who has found little success in school, namely the at-risk student.

Technology Education acquaints all students with their technological environment so they can make rational decisions about their own lives on a day-to-day basis and participate in controlling their own destiny. The program directs students to related technological and industrial fields, enabling students to realize their full potential and make maximum use of their individual talents in fulfilling career goals in their selected areas of employment.

Technology education capitalizes on the individual's potential for reasoning and problem solving, for imagining and creating, and for constructing and expressing through the use of tools and materials related to technology. It develops content and

TECHNOLOGY EDUCATION OVERVIEW

experiences to contribute to the growth and development of students commensurate with their potential. Thus, Technology Education is a basic and fundamental study for all persons in regard to career explorations and educational opportunities.

Opportunities to develop and apply leadership, social, civic, and technology related skills are provided through the Technology Student Association (TSA). TSA is the appropriate vocational student organization identified as a teaching tool for teachers to use in assisting students to achieve identified course competencies. Competency-based activities are an integral part of the instructionl program.

All Technology Education courses are taught in a one-period block of time (45-55 minutes), with each of the four Technology systems (communication, construction, manufacturing, and transportation, energy and power) being designed to provide a means through which other courses such as math, science, English, and social studies can be applied in a practical manner within a technology-based situation. Teaching across the curriculum is vital to the success of a Technology Education program.

TECHNOLOGY EDUCATION OVERVIEW

About the TLAs

The *Technology Education* series consists of 40 Technology Learning Activities (TLAs) for instruction and a supplemental activities book. Each TLA is divided into two parts: an instructor's guide and a student guide. The instructor's guide provides an overview of Technology Education, a summary of activities and supplies needed for students to complete the Technology Learning Activity, a supplies and materials worksheet for the instructor, an overview of the particular TLA, written exam answer sheets, and evaluation summary for the TLA.

Master copies of the evaluation summary sheets, pretest and posttest, and supplies and materials worksheets are provided with this instructors edition of the TLA. These sheets may be reproduced for classroom use.

All of the TLAs focus on measurable and observable learning outcomes. Instructors are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

TLAs are designed for use in more than one class period of instruction. Careful study of each TLA by the instructor will help her or him determine the following:

- Skills to demonstrate

TECHNOLOGY EDUCATION OVERVIEW

- Supplies and equipment needed
- Amount of time needed for student practice
- Workstation Bookshelf, Instructors Reference Materials, and a bibliography are provided for supplemental resources
- Supplementary materials, including print and non-print media to order
- Resource people to contact
- Facility modifications which may be necessary to administer the TLA

Each TLA is based on performance objectives. Performance objectives are specific, stating the performances necessary to meet the goal of the TLA.

The overall goal of the unit tells what the student should be able to do and what standard will be used to determine whether the student has achieved competency. The specific objectives outline the sequence of the competencies required to meet the TLA goal. The competencies may be either cognitive, requiring knowledge only, or psychomotor, requiring knowledge and skill.

TECHNOLOGY EDUCATION OVERVIEW

About Ordering TLAs

Additional TLAs in the *Technology Education* series may be ordered through the Oklahoma Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, OK 74074-4364. Phone 1-800-522-5810.

NOTE: The 1100- and 1200-series numbers given on the next page are for ordering TLA Instructors Editions; to order Student Editions, change the first two numbers to 31 (for 8-Day TLAs) or 32 (for 6-Week TLAs).

TECHNOLOGY EDUCATION OVERVIEW

TLA Title	Order No.
8-DAY TLAs	
Aerospace and Flight	TE1117
Agricultural Education	TE1123
Audiovisual Programming	TE1131
CAD — Autocad Release 10	TE1114
Career Search	TE1104
Drafting	TE1134
Electricity — Principles and Applications	TE1105
Electronic Publishing	TE1135
Electronics (CES)	TE1106
Fluidics Technology	TE1116
Health Occupations	TE1124
Home Economics	TE1125
Introduction to VoTech	TE1122
Introduction to Animation	TE1132
Keyboarding and Computer Application	TE1115
Laser/Fiber Optics/Holography	TE1129
Lasers Technology	TE1103
Marketing Education	TE1126
Material Processes — Plastics	TE1133
NASA Aerospace-Spacelink	TE1111
Photography	TE1130
Problem Solving	TE1110
Research and Design	TE1101
Residential Construction	TE1121
Robotics — Control Technology	TE1112
Robotics — ProArm	TE1113
Safety	TE1107
Structural Engineering	TE1102
Synergetic Technology	TE1120
Technical Report Writing	TE1118
Technology Challenge	TE1109
Thermal Screen Printing	TE1119
Trade and Industrial Education	TE1127
TSA Leadership	TE1108
Vocational Business	TE1128
6-WEEK TLAs	
Animator	TE1203
CAD/Board Drafting	TE1201
Control Technology	TE1202
Electronics/Electricity/Robotics	TE1204
Electronic Publisher	TE1205

TECHNOLOGY EDUCATION OVERVIEW

Corrections and Suggestions

CIMC wants to provide Technology Education instructors and students materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications or have suggestions for improving their usefulness, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and indicate the correction on the copy. Mail this information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Curriculum Development Coordinator
Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364

USING THIS PUBLICATION

INSTRUCTOR'S SECTION

Background Information

The background information component provides instructors with basic information about the subject of the TLA. Instructors are encouraged to use suggested resources for additional information on the specific technology used in each TLA.

Expected Learner Outcomes

There are 19 Expected Learner Outcomes for the *Technology Education* series. Not every TLA fulfills all 19 Expected Learner Outcomes, so outcomes specific to each TLA are listed in the Instructor's Section and in the Student's Section. The 19 Expected Learner Outcomes for the *Technology Education* series are:

- The student will know and appreciate the importance of technology and technological literacy.
- The student will explore career opportunities so they can make meaningful occupational choices.
- The student will explore future educational opportunities so they can make meaningful educational choices.
- The student will apply problem solving and critical thinking techniques.
- The student will apply math, science, reading, and other school subjects in a practical situation.
- The student will develop keyboarding and computer literacy skills.

USING THIS PUBLICATION

INSTRUCTOR'S SECTION

- The student will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- The student will recognize and develop individual talents.
- The student will think logically and sequentially.
- The student will develop leadership, creative abilities, positive self-concepts, and individual potential in a technological society.
- The student will become a more sophisticated consumer of the goods and services of a technological society.
- The student will adjust to a changing technological environment.
- The student will develop an understanding and the ability to adapt to those technological forces that influence life in the 21st Century.
- The student will develop an understanding of economic development.
- The student will communicate by making clear and relevant points through the development of mental process skills.

USING THIS PUBLICATION

INSTRUCTOR'S SECTION

- The student will apply design, imagination, and creative abilities.
- The student will learn applications of lifelong learning skills.
- The student will think globally and act locally.
- The student will explore the organization and management systems of business and industry.

Suggested Activities

The suggested activities component is to assist during the preparation stage of the teaching/learning process. The activities provide suggestions for preparation and evaluation during the instructional process. The instructor should read the suggested activities before assigning the TLAs to allow time to obtain supplemental materials, prepare audiovisual materials, and contact outside resource persons. Duties of the instructor will vary according to the particular TLA.

USING THIS PUBLICATION	INSTRUCTOR'S SECTION
Suggested Resources	Suggested resources, include people, and print and non-print media that may be used with the TLA. References used during the development of each TLA are also provided. The instructor can use suggested resources and TLA references to supplement her or his knowledge of the subject to help students with particular interests or objectives in the area covered. Please note that suggested resources and references listed in this publication existed when this publication was written. CIMC assumes no responsibility for providing these materials and cannot ensure the availability of these materials as individual vendors, manufacturers, and publishers may discontinue these products at any time.
Instructional Sequence	This component provides instructors with daily lesson plans for the TLA. Included in the instructional sequence component are suggested daily assignments and equipment, tools, and supplies that will be needed for each student. A column for facility requirements or modifications is provided for each instructor. This component is provided as a guide to plan for and monitor students' progress through the TLA.
Equipment, Tools and Supplies: Summary Worksheet	This component is provided as a planning tool for instructors. It provides instructors with a list of the necessary equipment, tools and supplies to support student activities and provides specific information for budgeting purposes.

USING THIS PUBLICATION	INSTRUCTOR'S SECTION
Pretest and Posttest	These components provide criterion-referenced evaluation of the objectives listed in each TLA. If objectives or activities have been added, deleted, or modified, appropriate changes should be made on the tests.
Test Answers	This component is provided to assist instructors in evaluating student performance on written tests.
Evaluation Summary	This component is provided to assist instructors in summarizing the performance of each student on an individual basis. The evaluation summary forms are also provided as photocopy masters for the instructors use.

USING THIS PUBLICATION

STUDENT'S SECTION

Introduction

Daily activities are the step-by-step procedures students will follow to complete the learning experience. Each TLA is organized by daily tasks and activities. Students are able to pace their progress through the TLA by referring to the activities for the day.

Within the daily activity pages are components common to all TLAs.

Summary of Activities

A Summary of Activities page begins each day of the TLA. This page provides several important pieces of information for both the student and instructor.

❶ In the left column this page provides the student with a list of activities to be accomplished that day.

❷ In the right column the major Academic and Workplace Application which applies to that day's activities is graphically indicated with a standard icon.

❸ Below the icon is a list of specific skills reinforced during that day's activities.

USING THIS PUBLICATION	STUDENT'S SECTION
Pretest Instructions	The students are required to take a Pretest as one of the first day's activities. The instructions for the Pretest are given in this section.
Assignments to Turn In	Day One includes a list of all assignments the students are expected to turn in during or at completion of the TLA. This list includes all tests, activities, and products covered in the TLA.
Goal	On Day One, following the assignments checklist, is a concise statement of the overall goal of the TLA. This statement summarizes the purpose for completing the TLA and encourages the student to think about the broader implications of the learning experience.
Words You Should Know	The first day's activities includes a glossary of unfamiliar technical terms used in the TLA. Often these terms are necessary for the student in order to accurately follow instructions in the activity procedures. The students should be encouraged to review this glossary and refer to it often during the course of the TLA.

USING THIS PUBLICATION	STUDENT'S SECTION
Expected Learner Outcomes Reinforced by this TLA	As stated in the guide to the Instructors Section, there are 19 identified Expected Learner Outcomes associated with the *Technology Education* series. This section of Day One activities lists the Expected Learner Outcomes that specifically apply to the TLA. A student who reviews this list will gain a better understanding of the scope of experiences and skills to be gained from the TLA.
Objectives	Each TLA is made up of a set of measurable objectives. In this section on Day One, students are given a list of all the objectives addressed in the TLA. This list can serve to introduce students to the "flow" of the TLA as they build introductory skills in a technology.
Related TSA Competitive Event(s)	Each TLA may be used by students to begin work toward completion of a Technology Student Association competitive event. Some TLAs are tied to a specific TSA event; other TLAs may be used with several events. This Day One section gives the student and instructor a list of appropriate TSA events which the TLA may support. TSA competitive events promote leadership development, and an understanding that winning isn't everything but involvement is. Events are staged at Local, Regional, State, and National levels through which the student may progress.

USING THIS PUBLICATION

STUDENT'S SECTION

Academic and Workplace Applications

The curricular content and activities found in this Technology Learning Activity help students apply academic and workplace competencies. These competencies include: Reading Skills, Writing Skills, Mathematics skills, Science Skills, Oral Communications Skills, Interpersonal or Relating Skills, Creative Thinking and Problem Solving Skills, Employability Skills, and Social Studies Skills.

Preparing students to enter successfully into today's world ...

Preparing students to enter successfully into today's world of work offers vocational education a substantial challenge. The contemporary workplace is characterized by constant and rapid technological change and by increasing job complexity and skill intensity. Due to rapid technological advancement, the half-life of work skills is now reduced to a bare three to five years. Out of this new workplace environment has arisen a growing national awareness of the critical importance of an American workforce armed with the skills necessary to survive in a competitive economy.

... emergence of a renewed emphasis on basic academic skills ...

One result of this national awareness has been the emergence of a renewed emphasis on basic academic skills in all areas of education. Pressure to increase academic skill development is being placed on education by both legislative action and industry mandate. The Carl D. Perkins Vocational and Applied Technology Education Act of 1990 sets stringent academic and workplace skill requirements for vocational education. State legislatures are increasingly requiring basic skills accountability by teachers and school administrators.

USING THIS PUBLICATION	STUDENT'S SECTION
... expected learner outcomes are being implemented with increasing frequency.	Graduation exams, minimum competency requirements, and expected learner outcomes are being implemented with increasing frequency. In addition, business and industry are delivering the message clearly to educators that vocational competence now requires increased strength in academic and workplace skills.
The issue of basic skills ... was successfully addressed in a national three-year study ...	The issue of the basic skills currently required in the work place was very successfully addressed in a national three-year study conducted jointly by the American Society of Training and Development (ASTD) and the U.S. Department of Labor (DOL). The findings of this study were published in 1990 in the book, *Workplace Basics: The Essential Skills Employers Want.*
... research indicates clearly that American employers ... need a variety of skills ...	The ASTD/DOL research indicates clearly that American employers have discovered that their workforces need a variety of skills that include, but are not limited to, the classic academic trio of reading, writing, and computation. Employers now are also looking for competence in areas such as "learning to learn," problem solving and critical thinking, interpersonal and teamwork skills, oral communication and listening techniques, and the social and personal management skills that demonstrate a capacity for independence and responsibility in on-the-job performance.

USING THIS PUBLICATION

STUDENT'S SECTION

... business and industry have expanded and re-defined "workplace basics."

It is clear that the requirements of today's business and industry have expanded and re-defined "workplace basics." It is in line with this re-definition, and with the competency requirements of current education legislation, that the Oklahoma Department of Vocational and Technical Education has chosen to address "basic skills" in the instructional materials produced by its Curriculum and Instructional Materials Center.

CIMC materials contain information and activities which develop academic and workplace application competencies ...

It is not a new development for CIMC materials to contain information and activities which develop academic and workplace application competencies in students undertaking vocational programs. What is new is the specific marking, or flagging, of items in our instructional materials that address academic and workplace application skills.

To assist teachers and students in identifying activities which promote academic and workplace skills ...

To assist teachers and students in identifying activities which promote academic and workplace skills development, CIMC has implemented a marking system which uses simple graphic symbols, or icons. These icons are located in the right margins of Activity Sheets. The following is an explanation of the icons and the kinds of academic and workplace application activities they indicate.

USING THIS PUBLICATION

READING SKILLS: Skills involving use of print resource material for obtaining and applying information.

WRITING SKILLS: Skills involving written communication of processes, information, or ideas.

MATHEMATICS SKILLS: Skills involving computation, calculation, and interpretation of numerical data.

STUDENT'S SECTION

Current vocational education literature indicates that functional literacy as a workplace basic needs to be defined in terms of reading competencies actually required for job performance. The activities identified with this icon as addressing reading skills in CIMC materials deal specifically with developing reading skills in an applied, job-related context. These range from general information-gathering activities to tasks requiring use of specific technical reference materials. Many contain a "learning to learn" aspect, which promotes engaging actively and purposefully in vocationally relevant inquiry.

Tasks identified with this icon promote development of skills in written communications. As with reading skills, the writing skills emphasized in CIMC materials have a vocational context. They include filling out forms, keeping work activity records, writing simple memos and letters, generating more complex reports and articles, and written expression of ideas and concepts related to vocational performance or exploration.

This icon identifies activities which develop vocationally-related skills in computation, measurement and estimation, selection and application of appropriate mathematical processes, and collecting, displaying, or interpreting data.

USING THIS PUBLICATION

SCIENCE SKILLS: Skills involving mastery and application of scientific information or theory.

ORAL COMMUN -ICATION SKILLS: Skills involving speaking and listening.

INTER-PERSONAL OR RELATING SKILLS: Skills involving working and getting along with others.

STUDENT'S SECTION

This icon marks activities which are related to the development of skills in either the physical or biological sciences. These skills stress occupationally-related applications of science and technology.

Activities marked with this icon promote development of effective speaking and listening. They include practice in such areas as speaking techniques, word choice, non-verbal messages, use of communication media, and using active listening techniques. Many of these activities promote "learning to learn" skills in verbal inquiry.

Activities which deal directly with skills in relating to others are marked with this icon. This includes areas such as multi-cultural awareness, group processes and dynamics, negotiation, dealing with conflict, cooperation and teamwork, values and attitudes, and leadership and motivation.

USING THIS PUBLICATION

STUDENT'S SECTION

CREATIVE THINKING AND PROBLEM SOLVING SKILLS: Skills involving comprehending, applying, analyzing, and developing complex ideas and situations.

This icon identifies activities which stress development of higher-order thought processes such as problem identification and analysis, lateral thinking, evaluating alternatives, developing solutions, examining assumptions, and evaluating outcomes.

EMPLOY-ABILITY SKILLS: Skills involving choosing, obtaining, and succeeding in a career.

Activities marked with this icon relate to competencies required to obtain employment and develop a career. These competencies include specific occupational tasks. They also include items such as career analysis and selection, job searching, completing applications and resumes, interviewing, and business etiquette and personal management skills required for job-keeping and maturing in one's work. Examples of the latter category include personal presentation, self-discipline, work accuracy, reliability, discretion, punctuality, stress handling, judgement, confidence, etc.

SOCIAL STUDIES SKILLS: Skills involving investi-gation and application of social concepts.

This icon marks activities which stress competencies in fields relating to human society and its distribution and relationships. This includes areas such as history, geography, government and politics, economics, psychology, sociology, demographics, current events, cross-cultural studies, consumer issues, environmental issues, and ethical concerns in science and technology.

USING THIS PUBLICATION

Impact Statements

STUDENT'S SECTION

There are five areas of human culture that each TLA impacts. These impact statements appear during Day Eight, after the student has gained some familiarity with the technology.

1. *ENVIRONMENTAL IMPACT:* A statement introducing the student to the impact of the technology on the environment.

2. *SOCIAL/CULTURAL IMPACT:* A statement concerning the impact of the technology on society and culture.

3. *ECONOMIC IMPACT:* A statement concerning the impact of the technology on the economy.

4. *POLITICAL IMPACT:* A statement concerning the impact of the technology on politics, laws, and regulations, and the impact of politics on the development of the technology.

5. *ERGONOMIC IMPACT:* A statement concerning the ergonomic implications of the technology. Ergonomics is the study of developing products and systems that meet peoples' needs.

USING THIS PUBLICATION

STUDENT'S SECTION

Impact Statements offer the student the opportunity to see beyond the activities in the Technology Learning Lab and glimpse the real-world applications of the technology.

Career Search

Also on Day Eight, the students are given the assignment of investigating several career opportunities related to the technology of the TLA. The investigation is done with *Career Search Abstracts.* A list of up to five related careers is given, followed by pages from *Career Search Abstracts* that detail the career qualifications and work environment. The student is required to choose two related careers, read the appropriate abstracts, then write a short essay about why that career may be appealing.

Posttest Instructions

The students are required to take a Posttest as one of the last day's activities. The instructions for the Posttest are given in this section. The score for the Posttest, compared to the score for the Pretest may help determine the student's gain during the TLA.

USING THIS PUBLICATION

Skunk Works

STUDENT'S SECTION

Skunk Works, a Day Eight optional activity, includes instructions that may be used for solving problems or reinforcing the enrichment of learning.

The term Skunk Works was coined by engineers at 3M Corporation in the mid-1960s. Some engineers wanted to develop a new product, but company management would not give them the time or money to work on the project. So the engineers "borrowed" time and money from approved projects to work on their "Skunk Works." When they finished developing the product, they presented it to management and it has been a 3M product ever since. The product: Velcro fasteners.

HAZARD ALERT MESSAGES

The Daily Activities include hazard alert information specific to the activity. These messages should be discussed carefully and thoroughly. The Hazard Alert Message system used in the TLA is based on the American National Standards Institute (ANSI) Standard Z535, which provides for five levels of alert.

Students are introduced to the ANSI Hazard Alert Message system as an activity in the Safety TLA (TE1107/TE3107). This system was adopted by ANSI as the standard in 1990 and will be the hazard alert system in use when students reach the workplace.

Hazard Alert Messages in the TLA are indicated both by the color red and graphically. There are three types of hazard alert graphics used in the TLA:

Hazard Alert Symbol

This Hazard Alert Symbol is used with the words DANGER, WARNING, and CAUTION. ANSI defines these words as:

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

HAZARD ALERT MESSAGES

Injury Hazard Graphic

There are two types of graphics used in conjunction with the hazard alert symbol. This type of graphic depicts a specific injury that may be expected if the hazard described in the alert is not avoided.

Avoidance Graphic

This second type of graphic is called an avoidance graphic. It depicts an action the student should take in order to avoid injury.

There are two other ANSI words used in the TLAs and the students should understand their meanings:

NOTICE indicates an action that could result in damage to property or equipment.

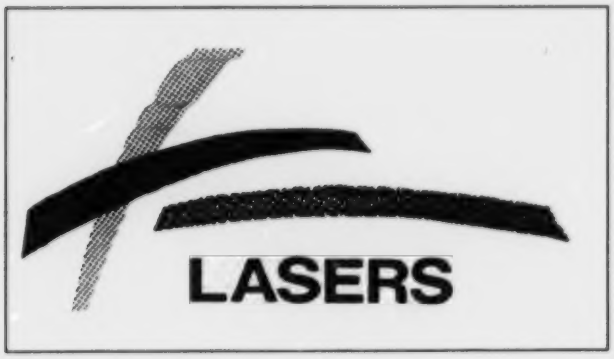
IMPORTANT indicates an instruction that can help the student do a better job.

TECHNOLOGY EDUCATION

LASERS

TE1103/TE3103

INSTRUCTOR'S SECTION



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BACKGROUND INFORMATION

Although it seems to be on the cutting edge of new technology, the laser was invented by Theodore H. Maman in 1960, before today's Technology Education students were even born.

Over the past three decades, science and industry have developed many uses for lasers. They are especially valuable to the communications industry. The use of fiber optics has revolutionized the industry, giving clearer communication at a lower cost.

Lasers have made many types of surgery safer, faster, and easier on the patient.

In industry, lasers are used to detect minute defects in manufactured parts and cut materials such as metal. A laser beam is powerful enough to drill a hole through a diamond.

INSTRUCTOR'S SECTION

SUGGESTED ACTIVITIES

- ✓ Obtain materials to supplement TLA.

NOTE: See Suggested Resources for computer software and books to supplement this module.

- ✓ Make arrangements for student to obtain ice cube from cafeteria or other area.
- ✓ Review instructional outline for this TLA. Modify time frames to suit class needs and plan activities for each class period.
- ✓ Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.
- ✓ Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.
- ✓ Determine how you will schedule time for students to demonstrate competence in the required procedures.
- ✓ Make arrangements for guest speakers. Supply speakers with specific objectives and other appropriate sections of this TLA.

INSTRUCTOR'S SECTION

PREPARATION

SUGGESTED ACTIVITIES

- ✓ Provide examples of products made with the use of lasers such as laser-cut stationery and desk accessories, holographic images on credit cards, etc.

INSTRUCTOR'S SECTION

EXPECTED LEARNER OUTCOMES

- The student will know and appreciate the importance of technology and technological literacy.
- The student will explore career opportunities so you can make meaningful career choices.
- The student will explore future educational opportunities so you can make meaningful educational choices.
- The student will apply problem-solving and critical thinking techniques.
- The student will apply math, science, reading, and other school subjects in a practical situation.
- The student will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- The student will recognize and develop individual talents.
- The student will think logically and sequentially.

INSTRUCTOR'S SECTION

EXPECTED LEARNER OUTCOMES

- The student will develop leadership, creative abilities, positive self-concepts, and individual potential in a technological society.
- The student will become a more sophisticated consumer of the goods and services of a technological society.
- The student will adjust to a changing technological environment.
- The student will develop an understanding of and the ability to adapt to those technological forces that influence life in the 21st Century.
- The student will communicate by making clear and relevant points through the development of mental process skills.
- The student will apply design, imagination, and creative abilities.
- The student will learn applications of lifelong skills.
- The student will think globally and act locally.

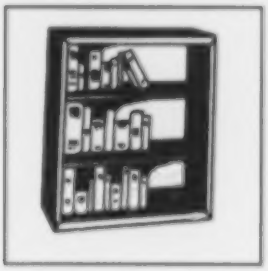
INSTRUCTOR'S SECTION

SUGGESTED RESOURCES

Hacker, Michael and Robert Barden. ***Living With Technology***, Albany, NY: Delmar Publishers, Inc., 1988.

INSTRUCTOR'S SECTION

WORKSTATION BOOKSHELF



INSTRUCTOR'S REFERENCE MATERIALS

Hacker, Michael and Robert Barden. ***Living With Technology***, Albany, NY: Delmar Publishers, Inc., 1988.

Hacker, Michael and Robert Barden. ***Technology in Your World***, Albany, NY: Delmar Publishers, 1992.

Listar, Glen. ***Technology Activity Guide 1***, Albany, NY: Delmar Publishers, Inc., 1987.

Technology Education: Introduction to Technology, Albany, NY: The University of the State of New York, 1987.

Instructional Sequence	Technology Education: Lasers		
	Assignments	**Equipment, Tools, and Supplies**	**Facilities Requirements/ Modifications**
Day 1	Take Pre-test Read and study Objectives, Student Learner Outcomes, Related Academic and Workplace Skills, and Information Sheets	Computer score card/sheet #2 pencil	
Day 2	Read Laser Safety sheets Take Laser Safety test	Computer score card/sheet #2 pencil	
Day 3	Complete Activity 3: Light diffusion in air	Laser Chalk dust Ice cube Paper, 8.5 X 11", 1 Pen or pencil Table	Darkened room
Day 4	Complete Activity 4: Light diffusion in liquid	Laser Florence flask Water Kool-aid (powder) Sand Flat-sided glass container Photographic film Convex lens Construction paper Tape Laser power meter	Darkened room

Instructional Sequence	Technology Education: Lasers		
	Assignments	**Equipment, Tools, and Supplies**	**Facilities Requirements/ Modifications**
Day 4 (continued)		Small mirror Chair Paper, 8.5 X 11", 1 Pen or pencil Table	
Day 5	Complete Activity 5: Light refraction	Laser Paper, 8.5 X 11", 2 Prism Pen or pencil	
Day 6	Complete Activity 6: Measuring with a laser	Laser Tape measure Tape Paper, 8.5 X 11", 2 Pen or pencil	Darkened room
Day 7	Complete Activity 7: Write laser report	Paper, 8.5 X 11, 1 Pen or pencil	
Day 8	Complete Career Search assignment. Read Implications. Complete any incomplete assignments. Take Post-test. Complete (1) Problem Solver if all other work has been completed.	Computer score card/sheet #2 pencil For Problem Solver: Laser Laser power meter Flat-sided glass container Sand Construction paper Convex lens Paper, 8.5 X 11", 1 Pen or pencil	Darkened room (problem solver)

Equipment, Tools, and Supplies
Summary Worksheet

Equipment, Tools, and Supplies	Per Student	Per Period	Total Needed	Special Considerations	Cost per Student	Cost per Period	Total Cost	Special Considerations
Laser	1							
Table	1							
Chair	1							
Computer score card/ sheet	1							
Pencil	1							
Paper, 8.5 X 11"	8							
Construction paper	1							
Photographic film	1							
Small mirror	1							
Convex lens	1							
Laser power meter	1							
Florence flask	1							
Flat sided glass container	1							
Sand	1 oz							
Tape measure	1							
Prism	1							
Water								
Kool-aid (powder)	1 tbls							
Measuring Spoon (1/8 teaspoon)	1							

PRETEST

1. Laser light is highly concentrated and pure in color.

   a. True
   b. False

2. Wavelength is the measurement, by a laser, of the distance between waves in the ocean.

   a. True
   b. False

3. Light rays that are parallel, or "in step," become stronger.

   a. True
   b. False

4. The narrow beam of a laser does not allow for the transmission of information over long distances.

   a. True
   b. False

5. The surgical use of lasers makes the healing process shorter.

   a. True
   b. False

6. Lasers are capable of cutting through steel as well as paper.

   a. True
   b. False

INSTRUCTOR'S SECTION

PART 1

PRETEST

7. The reading of a bar code on a product is done with a high-powered laser beam.

   a. True
   b. False

8. The helium-neon laser in our lab is Class .I.

   a. True
   b. False

9. Damage can be done to the eye before the blink reflex can block a laser beam.

   a. True
   b. False

10. Class IV lasers have the potential for the most hazards such as fire, damage to eyes, and damage to skin.

    a. True
    b. False

Spaces 11-30 on the answer sheet will be used for the Laser Safety Activity and Activity 6.

INSTRUCTOR'S SECTION

PART 2

POSTTEST

31. Laser light is highly concentrated and pure in color.

    a. True
    b. False

32. Wavelength is the measurement, by a laser, of the distance between waves in the ocean.

    a. True
    b. False

33. Light rays that are parallel, or "in step," become stronger.

    a. True
    b. False

34. The narrow beam of a laser does not allow for the transmission of information over long distances.

    a. True
    b. False

35. The surgical use of lasers makes the healing process shorter.

    a. True
    b. False

36. Lasers are capable of cutting through steel as well as paper.

    a. True
    b. False

INSTRUCTOR'S SECTION

PART 1

POSTTEST

37. The reading of a bar code on a product is done with a high-powered laser beam.

    a. True
    b. False

38. The helium-neon laser in our lab is Class II.

    a. True
    b. False

39. Damage can be done to the eye before the blink reflex can block a laser beam.

    a. True
    b. False

40. Class IV lasers have the potential for the most hazards such as fire, damage to eyes, and damage to skin.

    a. True
    b. False

INSTRUCTOR'S SECTION

PART 2

POSTTEST

41. Wavelenth
42. Lazer
43. Intensity
44. Hazardus
45. Reflection
46. Visibility
47. Impurfection
48. Partickles
49. Refraction
50. Diammeter

INSTRUCTOR'S SECTION

SPELLING TEST

TEST ANSWERS

1. True
2. False
3. True
4. False
5. True
6. True
7. False
8. True
9. True
10. True

11. True
12. True
13. False
14. False
15. False
16. True
17. True
18. True
19. True
20. False

21. C
22. C
23. A
24. D
25. A
26. C
27. D
28. D
29. C
21. A

INSTRUCTOR'S SECTION

PRETEST ANSWERS

LASER SAFETY ACTIVITY ANSWERS

ACTIVITY 6 ANSWERS

TEST ANSWERS

31. A
32. B
33. D
34. B
35. D
36. A
37. C
38. A
39. B
40. A
41. B
42. B
43. A
44. B
45. A
46. B
47. B
48. B
49. A
50. B

INSTRUCTOR'S SECTION

POSTTEST ANSWERS

EVALUATION SUMMARY

10 POINTS EACH:

Pretest ____

Career Search ____

Laser Safety Test ____

15 POINTS EACH:

Activity 1: Observe and describe the diffusion of laser light. ____

Activity 2: Observe and describe particles in fluids using laser light. ____

10 POINTS EACH:

Activity 3: Observe and describe refraction of sunlight and laser light through a prism. ____

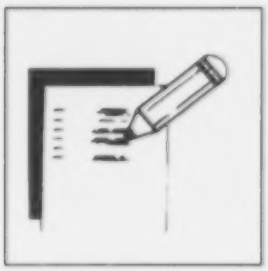
Activity 4: Estimate the diameter of a laser beam. ____

Activity 5: Write a one-page essay on the uses of lasers. ____

Laser Definitions ____

INSTRUCTOR'S SECTION

1. PROCESS EVALUATION



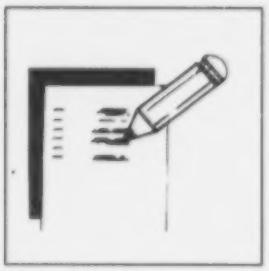
1. PROCESS EVALUATION SCORE _____

EVALUATION SUMMARY

Posttest score = _____

INSTRUCTOR'S SECTION

2. WRITTEN EVALUATION



2. WRITTEN EVALUATION SCORE _____

EVALUATION WORKSHEET

1. Process evaluation score = _____

2. Written evaluation score = _____

3. Total written score = _____

Divide Total Score by 2.

Total Score for TLA =

1 + 2 = 3

Total Score/2 = SCORE

TLA SCORE _____

BIBLIOGRAPHY

Hacker, Michael, and Robert Barden. *Living With Technology.* Albany, New York: Delmar Publishers, Inc., 1988.

Hacker, Michael, and Robert Barden. *Technology in Your World.* Albany, New York: Delmar Publishers, Inc., 1992.

Listar, Glen. *Technology Activity Guide 1.* Albany, New York: Delmar Publishers, Inc., 1987.

Technology Education: Introduction to Technology. Albany, New York: The University of the State of New York, 1987.

INSTRUCTOR'S SECTION

TECHNOLOGY

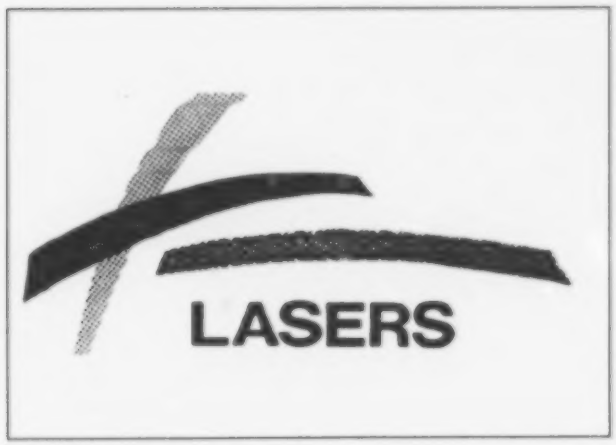
LEARNING

ACTIVITY

TE3103

LASERS

Suggested Time: 8 Days



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Oklahoma Department of Vocational and Technical Education

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Curriculum and Instructional Materials Center

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TECHNOLOGY EDUCATION
LASERS

DAY 1 ACTIVITIES

On Day 1 you should complete the following activities:

1. Complete Pre-test
2. Read Assignments to Turn In (items to complete in 8 days)
3. Read Goal
4. Read Words You Should Know
5. Read Expected Learner Outcomes
6. Read Objectives
7. Read Related TSA Competitive Events
8. Read Academic and Workplace Applications

SUMMARY OF ACTIVITIES

Reading Comprehension Skills:
- Gain factual information
- Make generalizations

Functional Reading Skills:
- Follow written instructions
- Interpret graphics and symbols

TECHNOLOGY EDUCATION
LASERS

DAY 1 ACTIVITIES

PRETEST

INSTRUCTIONS

You will need a computer scan sheet or card to record your answers to the following Pre-test. Be sure to write your name, the title of the TLA, the date, and the class period on the computer scan sheet or card using a #2 pencil. Use rows 1-10 to record the answers to the Pre-test. If your answers will be hand-scored, use a blank sheet of paper to record your answers and number your answers 1-10.

Get Pretest Questions from your instructor.

TECHNOLOGY EDUCATION LASERS

DAY 1 ACTIVITIES

ASSIGNMENTS TO TURN IN

At the end of 8 days, you should give the following items to your instructor for evaluation:

1. **Computer score card/sheet, with answers to:**
   - a) Pre-test
   - b) Laser Safety test
   - c) Post-test

2. **Career Search Activity**
   - a) Two occupations identified
   - b) Explanation of why those occupations appealed to you

3. **Answers to Activity Questions**
   - a) Answers to questions from Activity 1: light diffusion in the air
   - b) Answers to questions from Activity 2: light diffusion in liquid
   - c) Answers to questions from Activity 3: light refraction
   - d) Answers to questions from Activity 4: measure using a laser beam

4. **Laser Essay**
   - a) An essay describing different uses of lasers that you see in your life

TECHNOLOGY EDUCATION
LASERS

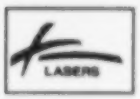
DAY 1
ACTIVITIES

GOAL

The Lasers TLA will help you learn more about how lasers work and what they can do. You will see how common lasers are, and how often you come in contact with them in your daily routine.

TECHNOLOGY EDUCATION LASERS

DAY 1 ACTIVITIES



WORDS YOU SHOULD KNOW

Colloidal	Having very finely divided particles.
Converge	To approach one common center or single point.
Crystalline	Having a structure made up of crystals.
Fluid	Liquid.
Focus	The spot where light rays all come together by the use of mirrors or lenses.
Hologram	A three-dimensional picture made by a laser.
Intensity	Degree of strength, energy, or force.
Laser	Light Amplification by Stimulated Emission of Radiation.
Opaque	Does not allow light to pass through.
Particle	A very small portion, piece, or amount.
Polarize	To cause light waves to vibrate in a particular way.
Polluted	Fouled or unclean, dirty.

TECHNOLOGY EDUCATION
LASERS

DAY 1
ACTIVITIES

WORDS YOU SHOULD KNOW
(Continued)

Reflection The return of heat, light, or images by a reflecting surface (such as a mirror).

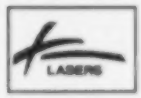
Refraction The bending of a ray of light when it passes from one medium to another in which its speed is different (such as from air to water).

Visibility The degree of clearness.

Wavelength The distance between the crests of waves.

TECHNOLOGY EDUCATION LASERS

DAY 1
ACTIVITIES



EXPECTED LEARNER OUTCOMES

- You will know and appreciate the importance of technology and technological literacy.
- You will explore career opportunities so you can make meaningful career choices.
- You will explore future educational opportunities so you can make meaningful educational choices.
- You will apply problem-solving and critical thinking techniques.
- You will apply math, science, reading, and other school subjects in a practical situation.
- You will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- You will recognize and develop individual talents.
- You will think logically and sequentially.

TECHNOLOGY EDUCATION LASERS

DAY 1
ACTIVITIES

EXPECTED LEARNER OUTCOMES
(Continued)

- You will develop leadership, creative abilities, positive self-concepts, and individual potential in a technological society.
- You will become a more sophisticated consumer of the goods and services of a technological society.
- You will adjust to a changing technological environment.
- You will develop an understanding and the ability to adapt to those technological forces that influence life in the 21st Century.
- You will communicate by making clear and relevant points through the development of mental process skills.
- You will apply design, imagination, and creative abilities.
- You will learn applications of lifelong skills.
- You will think globally and act locally.

TECHNOLOGY EDUCATION LASERS

DAY 1 ACTIVITIES

OBJECTIVES

At the completion of this Technology Learning Activity the student should be able to:

1. Describe the diffusion of laser light by chalk dust and an ice cube.
2. Describe particles in liquids using laser light and a power meter.
3. Describe laser light and sunlight refraction through a prism.
4. Estimate the diameter of a laser beam and check this estimate by measuring the beam.
5. Write a 1-page essay, using correct spelling and grammar, about the uses of lasers.
6. Correctly define (by matching) 10 terms associated with lasers.

TECHNOLOGY EDUCATION LASERS

DAY 1 ACTIVITIES

Related TSA Competitive Events

The following TSA Competitive Events apply to your study of lasers:

- Technical Process Display
- Technical Report Writing
- Research Paper
- Safety Poster
- Extemporaneous Speech
- Prepared Speech

See *TSA Competitive Events Guidelines* for specific details on the competitions.

TECHNOLOGY EDUCATION
LASERS

DAY 1
ACTIVITIES

ACADEMIC AND WORKPLACE APPLICATIONS

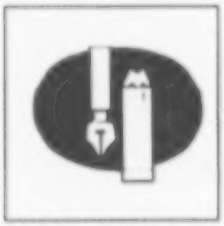
The symbols in the right column are used to identify the Academic and Workplace Applications that are reinforced by specific activities in this TLA.

Although each of the nine Academic and Workplace Application areas is applicable to Lasers and the content of this TLA, the following competencies are specifically reinforced:

Reading Skills Applied:

Reading Comprehension Skills:
- Gain factual information
- Make generalizations
- Distinguish fact, opinion, and inference

Functional Reading Skills:
- Follow written instructions
- Interpret graphics and symbols
- Use content area vocabulary



Writing Skills Applied:

Language Skills:
- Use standard grammar, spelling, punctuation, capitalization

Composition Skills:
- Use complete sentences
- Use topic sentences

TECHNOLOGY EDUCATION
LASERS

DAY 1 ACTIVITIES

ACADEMIC AND WORKPLACE APPLICATIONS
(Continued)

Math Concepts Applied:

Math Application Skills:

- Apply mathematical formula

Science Concepts Applied:

General Science Skills:

- Apply scientific method of inquiry
- Conduct experiments
- Use scientific instruments
- Investigate economics in technology

Physical Science Skills:

- Investigate forms/changes of matter
- Investigate forms of energy
- Investigate physical laws

If you complete Day 1 Activities with time left over, you may begin Day 2 Activities.

TECHNOLOGY EDUCATION
LASERS

DAY 2 ACTIVITIES

On Day 2 you should complete the following activities:

1. Read Information Sheets.
2. Read Laser Safety.
3. Complete Laser Safety Activity.

SUMMARY OF ACTIVITIES

Reading Comprehension Skills:
- Gain factual information
- Distinguish fact, opinion and inference

Functional Reading Skills:
- Follow written instructions

TECHNOLOGY EDUCATION LASERS

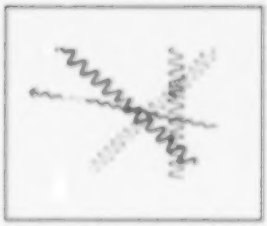
DAY 2 ACTIVITIES

INFORMATION SHEET

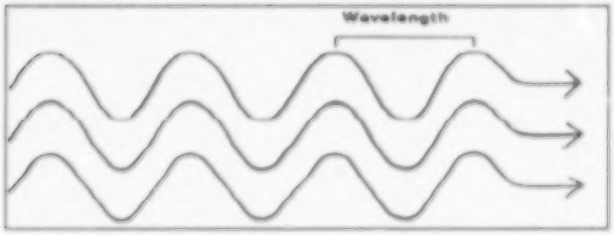
INTRODUCTION

The word *laser* stands for Light Amplification by Stimulated Emission of Radiation. A laser is a device which produces beams of a special kind of light — laser light.

Laser light is different from ordinary light. Ordinary white light, such as the light from a flashlight, is made up of many different colors of light mixed together. A laser beam is made of light of only one color. Both kinds of light are made of **light waves**. Because ordinary light is made of different colors of light, the light waves are slightly different and go in different directions.



This is why ordinary light spreads out in all directions, as you can see by looking at the beam of a flashlight. Laser light is only one color of light, so its light waves are identical. The waves stay "locked" together like pieces in a puzzle, so the beam is concentrated and much stronger than ordinary light, and goes in only one direction.



TECHNOLOGY EDUCATION
LASERS

DAY 2 ACTIVITIES

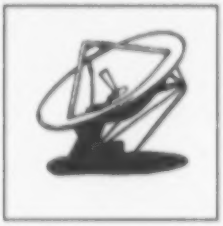
INTRODUCTION
(Continued)

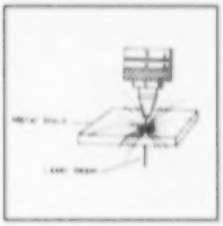
Because laser light is made of pure, concentrated beams of only one color, it can travel in a narrow beam over great distances. It can also be very intense — even as intense as the sun.

These qualities make laser light important in many different fields. In communication, laser beams are used to transmit telephone calls, television broadcasts, computer data, and information to satellites.

In industry, lasers are used to cut, drill, engrave, and weld materials such as paper, plastics, fabric, and steel. They are also very important in testing for strengths and weaknesses of materials and parts.

Lasers are used in medicine to remove or destroy growths. Heat from lasers can seal blood vessels to prevent bleeding. Laser surgery causes little or no pain for the patient, and the healing time is faster than if a scalpel were used.

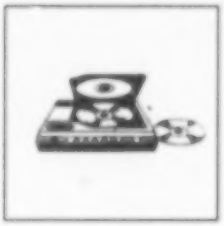




TECHNOLOGY EDUCATION
LASERS

DAY 2 ACTIVITIES

INTRODUCTION
(Continued)



You may not realize how often you come in contact with lasers in your daily life. For example, you may buy a compact disc at a record store. The clerk will pass the package over a laser beam to read the UPC code for the automatic cash register. You may pay with a credit card that has a holographic image, made by laser light, to help prevent counterfeiting. When you get home you pop the disc into your disc player, which reads the information on the disc by laser.

The future of lasers is unlimited due to the wide range of applications in industry, medicine, science, and national defense, just to name a few.

PARTS OF A LASER

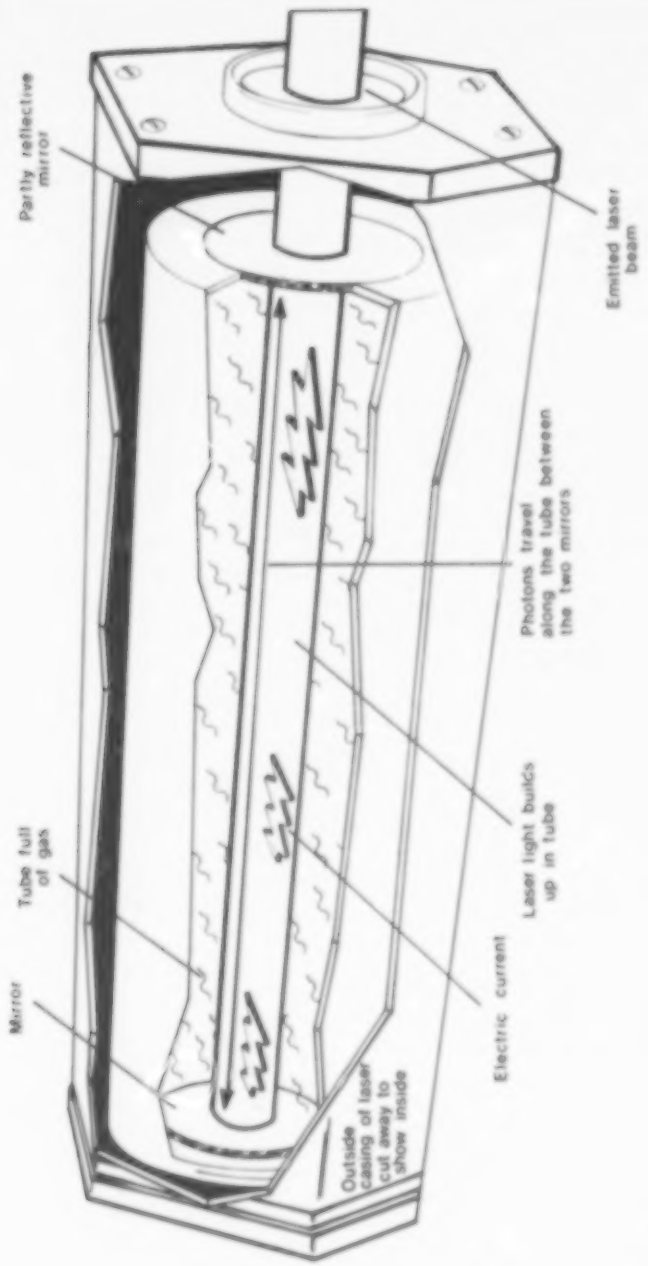
All lasers generally consist of four major parts: the active medium, excitation mechanism, feedback mechanism, and an output coupler. See the figure on the next page for a cutaway view of a laser.

ACTIVE MEDIUM

The **active medium** is the material in which the laser light is produced. The first laser used a solid ruby rod as the active medium. Scientists have since found out that almost any material can produce laser action, even Jello. Of course, some materials work more effectively than others. Powerful lasers used in industry often use carbon dioxide as the active medium, while helium-neon is more common in smaller demonstration lasers.

TECHNOLOGY EDUCATION
LASERS

DAY 2
ACTIVITIES


Partly reflective mirror
Emitted laser beam
Photons travel along the tube between the two mirrors
Laser light builds up in tube
Tube full of gas
Mirror
Electric current
Outside casing of laser cut away to show inside

BEST COPY AVAILABLE

TECHNOLOGY EDUCATION
LASERS

DAY 2 ACTIVITIES

EXCITATION MECHANISM

The **excitation mechanism** is used to put energy into the active medium. There are three primary types of excitation mechanisms: optical (light), electrical, and chemical. The process of giving energy to the active medium is called "pumping" the laser. Electrical excitation is most commonly used when the active medium will support an electric current. The helium-neon laser uses electrical excitation.

FEEDBACK MECHANISM

Mirrors at each end of the active medium are used as **feedback mechanisms**. These mirrors reflect the light produced in the active medium back and forth through the medium. This keeps the light inside the laser cavity.

OUTPUT COUPLER

An **output coupler** allows some of this light to escape to produce the laser beam. This output coupler is usually one of the mirrors in the feedback mechanism. The mirror on one end of the active medium reflects all of the light back into the medium. However, the other mirror is not 100% reflective, and allows a very small percentage of the light to pass through the mirror. Only light which has reached a high intensity level is able to shine through the mirror.

TECHNOLOGY EDUCATION
LASERS

DAY 2
ACTIVITIES

INTRODUCTION
(Continued)

A laser is classified according to the potential hazards which exist while it is being used. There are four major classifications of lasers.

Class I: These are lasers that produce a light beam which is below a hazardous level. Lasers in this classification would generally be used in laser light shows and store checkout counters. Because operators and bystanders are not exposed to hazardous laser light from a Class I system, very few warning labels are required. The word "laser" does not have to appear on the label. This is especially important in locations where the word *laser* may trigger fear in people. When the first supermarket checkout systems were developed, there was a great deal of concern that people would see the word *laser* on warning signs and avoid the store for fear of the unknown.

Laser Classifications
Class I Lasers

Laser Classifications

Class II Lasers

Class II: Class II lasers are also referred to as "demonstration lasers." The lasers in this classification are required to have a warning label, a protective housing, an indicator to show when the power is on, and a method to block the beam without turning off the power. These lasers can cause eye damage if the eye is deliberately exposed to the bright light. The brightness of the light would cause a normal eye to blink before injury could occur. The helium-neon laser in our lab is Class II.

Class III Lasers

Class III: Lasers in this class are considerably more dangerous than the Class II lasers. The beam from a Class III laser can cause eye damage before the blink reflex can block the beam. These lasers require additional safety measures, such as a red danger sign, a key-activated master switch, and a delay mechanism. Accidental exposure to the laser beam is greatly reduced by these safety features. Carbon dioxide lasers used in industry for materials processing are usually Class III lasers.

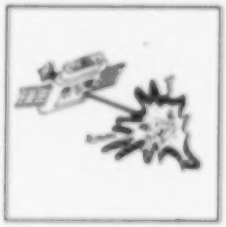
TECHNOLOGY EDUCATION
LASERS

Class IV: This class contains all lasers that are more powerful than Class III lasers. They are a great potential hazard to the eye and to exposed skin. They can produce enough light energy to burn any combustible materials that their beams contact, so they are considered a fire hazard. These lasers are primarily used in research laboratories and for military purposes.

DAY 2 ACTIVITIES

LASERS

Laser Classifications
Class IV Lasers



TECHNOLOGY EDUCATION
LASERS

DAY 2 ACTIVITIES

INTRODUCTION
(Continued)

LASER SAFETY

In many laser systems, the electrical power supply is even more dangerous than the laser beam. Voltages in excess of 1000 volts are present even in low-power lasers. A Class II laser, like the laser in our lab, is capable of producing up to 5000 volts of power, which could easily cause serious personal injury. The laser power supply should always be enclosed in a suitable housing.

WARNING
ELECTROCUTION POSSIBLE. Laser can shock or electrocute. DO NOT REMOVE PROTECTIVE HOUSING.

When working with Class II lasers, observe the following safety precautions.

1. Do not stare into the laser beam, or reflections of the beam from shiny objects. The reflection from a flat, mirror-type surface is as dangerous as the beam itself. Reflections from diffuse surfaces, such as a wall, are not considered dangerous for Class II lasers.

LASER SAFETY
(Continued)

2. Do not point the laser at your own or anybody else's eyes. To help prevent this, always keep the laser below eye level when it is turned on.

3. Do not track vehicles or aircraft with a laser beam. To help prevent this, never point the laser beam through windows or open doors.

4. Do not leave an operating laser unattended. Be sure to unplug it when it is not in use.

5. Do not operate the laser with the power supply exposed. If the housing is loose or not totally in place, do not operate the laser. Tell your instructor.

6. Be sure that the laser is properly grounded. It is equipped with a three-prong electrical plug and must be plugged into a grounded three-prong outlet. Never use an adapter to plug the laser into a two-prong outlet.

LASER SAFETY ACTIVITY

INSTRUCTIONS

You will need a computer scan sheet or card to record your answers to the following test. Be sure to write your name, the title of the TLA, the date, and the class period on the computer scan sheet or card using a #2 pencil. Use rows 11-20 to record the answers to the test. If your answers will be hand-scored, use a blank sheet of paper to record your answers and number your answers 11-20.

LASER SAFETY ACTIVITY
PART 1

11. The reflection of a laser beam from a mirror-like surface is as dangerous as the beam itself.

    a) True
    b) False

12. The laser beam should be kept below eye level.

    a) True
    b) False

13. It is all right to leave an operating laser unattended for a few minutes when necessary.

    a) True
    b) False

LASER SAFETY ACTIVITY
PART 2

14. A laser does not require a three-prong ground plug.

    a) True
    b) False

15. It is all right to open the laser housing to look inside.

    a) True
    b) False

16. A Class II laser can cause eye damage if the eye is deliberately exposed to the laser beam.

    a) True
    b) False

17. Reflections from diffuse surfaces, such as a wall, are not considered dangerous for Class II lasers.

    a) True
    b) False

18. A Class II laser is capable of producing up to 5000 volts of electricity in the power supply.

    a) True
    b) False

TECHNOLOGY EDUCATION
LASERS

DAY 2 ACTIVITIES

LASER SAFETY ACTIVITY
PART 3

19. Lasers are capable of storing high voltages even after they have been unplugged.

    a) True
    b) False

20. The laser can safely be used to track moving vehicles.

    a) True
    b) False

You must score 100% on this activity. Hand your answers to your instructor for grading before you begin Day 3 Activities.

If you complete Day 2 Activities with time left over, you may begin Day 3 Activities.

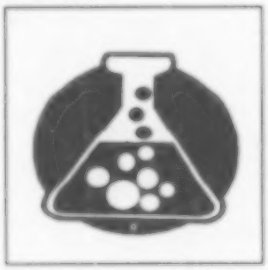
TECHNOLOGY EDUCATION
LASERS

DAY 3 ACTIVITIES

On Day 3 you should complete the following activities:

1. Perform Experiment 1
2. Perform Experiment 2

SUMMARY OF ACTIVITIES



General Science Skills:
- Apply scientific method of inquiry
- Conduct experiments
- Use scientific instruments

Physical Science Skills:
- Investigate forms/changes of matter

TECHNOLOGY EDUCATION
LASERS

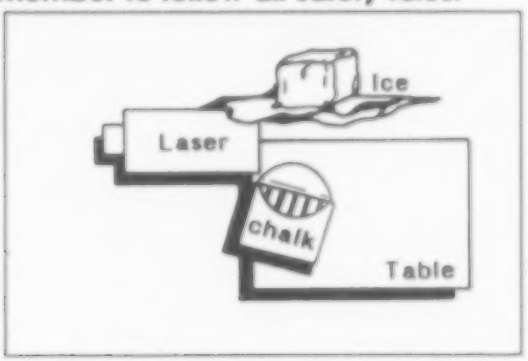
DAY 3 ACTIVITIES

OBJECTIVE 1

Describe the diffusion of laser light through chalk dust and an ice cube.

Remember to follow all safety rules!

TOOLS AND MATERIALS



- Laser
- Chalk dust
- Ice cube (Ask your instructor where to get the ice cube. Do not leave the lab without permission.)
- Table

TECHNOLOGY EDUCATION
LASERS

DAY 3
ACTIVITIES

EXPERIMENT 1

In this experiment you will observe light from a laser being scattered by particles (chalk dust).

FOLLOW THESE STEPS:

STEP 1: Take all materials into a darkened room.

STEP 2: Put the laser on the table, making sure it is below eye level. Turn on the laser.

Experimental Set-up

CAUTION
EYE DAMAGE POSSIBLE. Do not stare directly into laser beam.

TECHNOLOGY EDUCATION
LASERS

DAY 3 ACTIVITIES

FOLLOW THESE STEPS:

EXPERIMENT 1
(Continued)

STEP 3: Shake the chalk dust into the light beam.

STEP 4: On a sheet of paper, write short (1 paragraph) answers to the following questions.

ACTIVITY REPORT

1. Describe what you saw.

2. Why do you think this happened?

TECHNOLOGY EDUCATION
LASERS

DAY 3
ACTIVITIES

EXPERIMENT 2

FOLLOW THESE STEPS:

STEP 1: Take all materials into a darkened room.

STEP 2: Put the laser on the table, making sure it is below eye level. Turn on the laser.

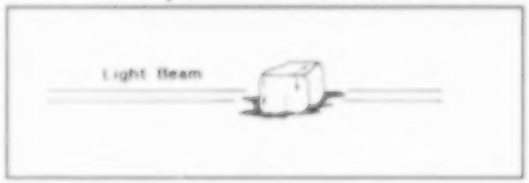
CAUTION
EYE DAMAGE POSSIBLE. Do not stare directly into laser beam.

TECHNOLOGY EDUCATION LASERS

DAY 3 ACTIVITIES

FOLLOW THESE STEPS:

STEP 3: Put the ice cube in the path of the laser beam and observe the imperfections in the crystalline structure of the ice.



EXPERIMENT 2
(Continued)

Experimental Set-up

STEP 4: On the same sheet of paper, describe and/or draw the imperfections you saw in the ice's structure.

ACTIVITY REPORT

STEP 5: When you finish, clean work area and return tools and materials to their proper storage areas.

If you complete Day 3 Activities with time left over, you may begin Day 4 Activities.

TECHNOLOGY EDUCATION
LASERS

DAY 4 ACTIVITIES

On Day 4 you should complete the following activities:

1. Perform Experiment 3.
2. Perform Experiment 4.

SUMMARY OF ACTIVITIES

General Science Skills:
- Apply scientific method of inquiry
- Conduct experiments
- Use scientific instruments (laser)

Physical Science Skills:
- Investigate forms of energy

TECHNOLOGY EDUCATION
LASERS

DAY 4 ACTIVITIES

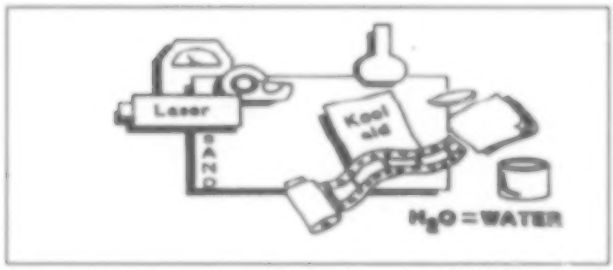
OBJECTIVE 2

Observe and describe particles in liquids, using laser light and a power meter.

INTRODUCTION

Using the laser, you can detect particles in liquids and see how the particles affect the amount of laser light travelling through the liquid.

TOOLS AND MATERIALS



- Laser
- Table
- Florence flask
- Photographic film
- Water
- Kool-aid powder

TOOLS AND MATERIALS (continued)

- Masking tape
- Small mirror
- Laser power meter
- Glass container with flat sides
- Construction paper mask (approx. 5" X 5")
- Convex lens
- Sand
- Measuring spoon (1/8 teaspoon)

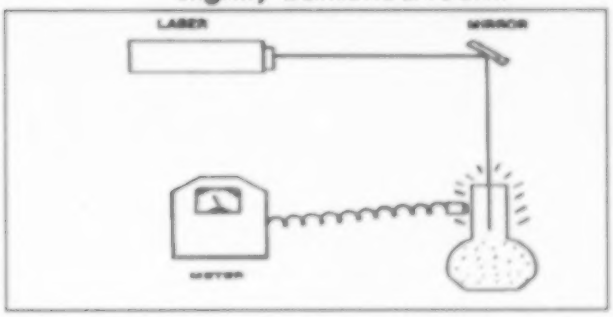
TECHNOLOGY EDUCATION
LASERS

DAY 4
ACTIVITIES

EXPERIMENT 3

FOLLOW THESE STEPS:

STEP 1: Put the laser on the table in a slightly darkened room.



Experimental Set-up

STEP 2: Tape the photographic film over the laser so the light passes through the film. This will polarize the laser beam.

STEP 3: Fill the florence flask with water and add ⅛ teaspoon of Kool-aid powder. Stir.

STEP 4: Put the flask on a chair next to the laser and turn the laser on. Use the mirror to aim the laser beam down the neck of the flask (see set-up diagram above).

TECHNOLOGY EDUCATION
LASERS

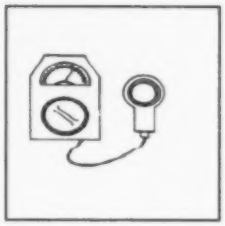
DAY 4
ACTIVITIES

EXPERIMENT 3
(Continued)

CAUTION
EYE DAMAGE POSSIBLE. Do not stare directly into laser beam.

FOLLOW THESE STEPS:

STEP 5: Move the power meter around to measure the light intensity from different areas.



STEP 6: On a sheet of paper, write short (1 paragraph) answers to the following questions.

ACTIVITY REPORT

1. Describe what you saw.

2. Why do you think this happened?

TECHNOLOGY EDUCATION
LASERS

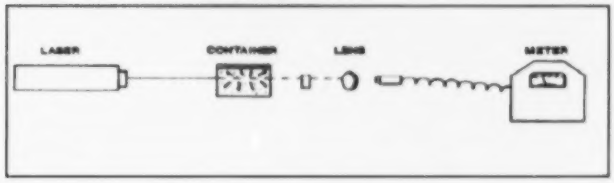
DAY 4
ACTIVITIES

LASERS

FOLLOW THESE STEPS:

EXPERIMENT 4

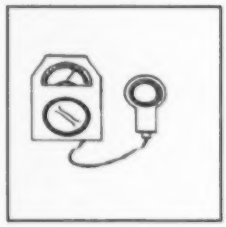
STEP 1: Fill a flat-sided glass container with a transparent liquid and place it on the table in front of the laser.



STEP 2: Aim the beam through the container and tape the small opaque mask on the side of the container where the laser beam comes through. Remember not to look directly into the beam.

STEP 3: Place a small amount of sand in the water.

STEP 4: As the sand begins to sink, hold the lens next to the opaque mask and use the power meter to measure the intensity of the light coming through the liquid (see set-up diagram above).



TECHNOLOGY EDUCATION
LASERS

DAY 4 ACTIVITIES

EXPERIMENT 4
(Continued)

FOLLOW THESE STEPS:

STEP 5: On the same sheet of paper, answer the following questions:

3. Describe what you saw.

4. Why do you think this happened?

STEP 6: When you finish, clean work area and return tools and materials to their proper storage areas.

If you complete Day 4 Activities with time left over, you may begin Day 5 Activities.

ACTIVITY REPORT

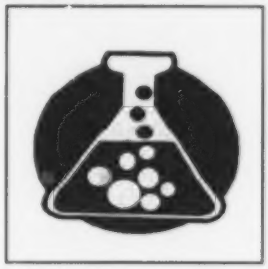
TECHNOLOGY EDUCATION
LASERS

DAY 5 ACTIVITIES

On Day 5 you should complete the following activities:

1. Perform Experiment 5.

SUMMARY OF ACTIVITIES



General Science Skills:
- Apply scientific method of inquiry
- Conduct experiments
- Use lasers

Physical Science Skills:
- Investigate physical laws

TECHNOLOGY EDUCATION
LASERS

DAY 5 ACTIVITIES

OBJECTIVE 3

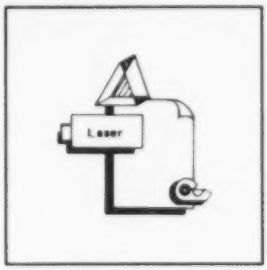
Observe and describe the refraction of sunlight and laser light through a prism.

INTRODUCTION

As you read earlier, "regular" light (such as sunlight) is made up of many different colors of light, while laser light is all pure light of one color. You can use a prism to break sunlight into its different colors, and see what happens when you try this with laser light.

TOOLS AND MATERIALS

- Laser
- Prism
- White paper
- Masking tape



TECHNOLOGY EDUCATION
LASERS

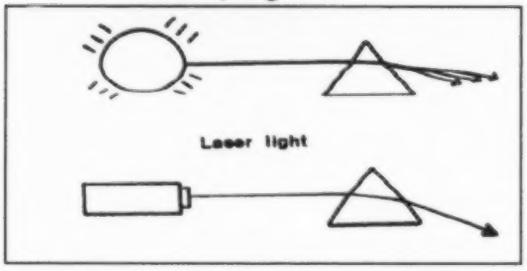
DAY 5 ACTIVITIES

EXPERIMENT 5

FOLLOW THESE STEPS:

STEP 1: Tape the paper to the floor or a wall near a window or open door.

STEP 2: Hold the prism in front of a window or open door and move it until you can see a spectrum (rainbow) on the paper. If you need to, move the paper to a different spot and try again.



Experimental Set-up

STEP 3: Count the number of different colors you see in the spectrum.

STEP 4: Move the paper near the laser and turn it on.

CAUTION
EYE DAMAGE POSSIBLE. Do not stare directly into laser beam.

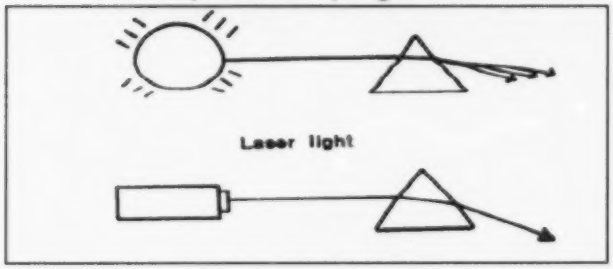
TECHNOLOGY EDUCATION
LASERS

DAY 5 ACTIVITIES

EXPERIMENT 5
(Continued)

FOLLOW THESE STEPS:

STEP 5: Hold the prism in the laser beam and move it until you see the light refracted onto the paper. If you need to, move the paper to a different spot and try again.



STEP 6: Count the number of different colors you see.

STEP 7: On a sheet of paper, write short (1 paragraph) answers to the following questions.

1. How many colors did you see in the sunlight spectrum? What does this tell you about sunlight?

2. How many colors did you see in the laser light spectrum? What does this tell you about laser light?

ACTIVITY REPORT

TECHNOLOGY EDUCATION LASERS

DAY 5 ACTIVITIES

FOLLOW THESE STEPS:

3. What do you think would happen if you tried this experiment with light from a flashlight or a fluorescent light?

STEP 8: When you finish, clean work area and return tools and materials to their proper storage areas.

If you complete Day 5 Activities with time left over, you may begin Day 6 Activities.

ACTIVITY REPORT
(Continued)

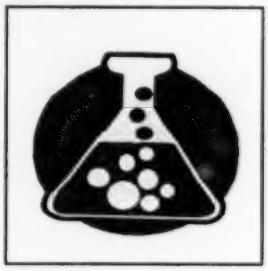
TECHNOLOGY EDUCATION
LASERS

DAY 6 ACTIVITIES

On Day 6 you should complete the following activities:

1. Perform Experiment 6.

SUMMARY OF ACTIVITIES



General Science Skills:
- Conduct experiments
- Investigate/apply economics in technology
- Use lasers

Physical Science Skills:
- Investigate/apply physical laws

TECHNOLOGY EDUCATION
LASERS

DAY 6 ACTIVITIES

OBJECTIVE 4

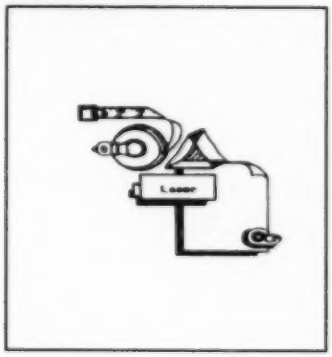
Estimate the diameter of a laser beam, and check this estimate by measuring the laser beam.

INTRODUCTION

Unlike a flashlight beam, a laser beam does not spread much as it travels. In this experiment you will estimate how much the laser beam will spread and see how close you were to the actual measurement. You will also see how surveyors can use a laser to measure long distances.

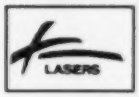
TOOLS AND MATERIALS

- Laser
- Sheet of paper
- Masking tape
- Tape measure



TECHNOLOGY EDUCATION
LASERS

DAY 6
ACTIVITIES



EXPERIMENT 6

FOLLOW THESE STEPS:

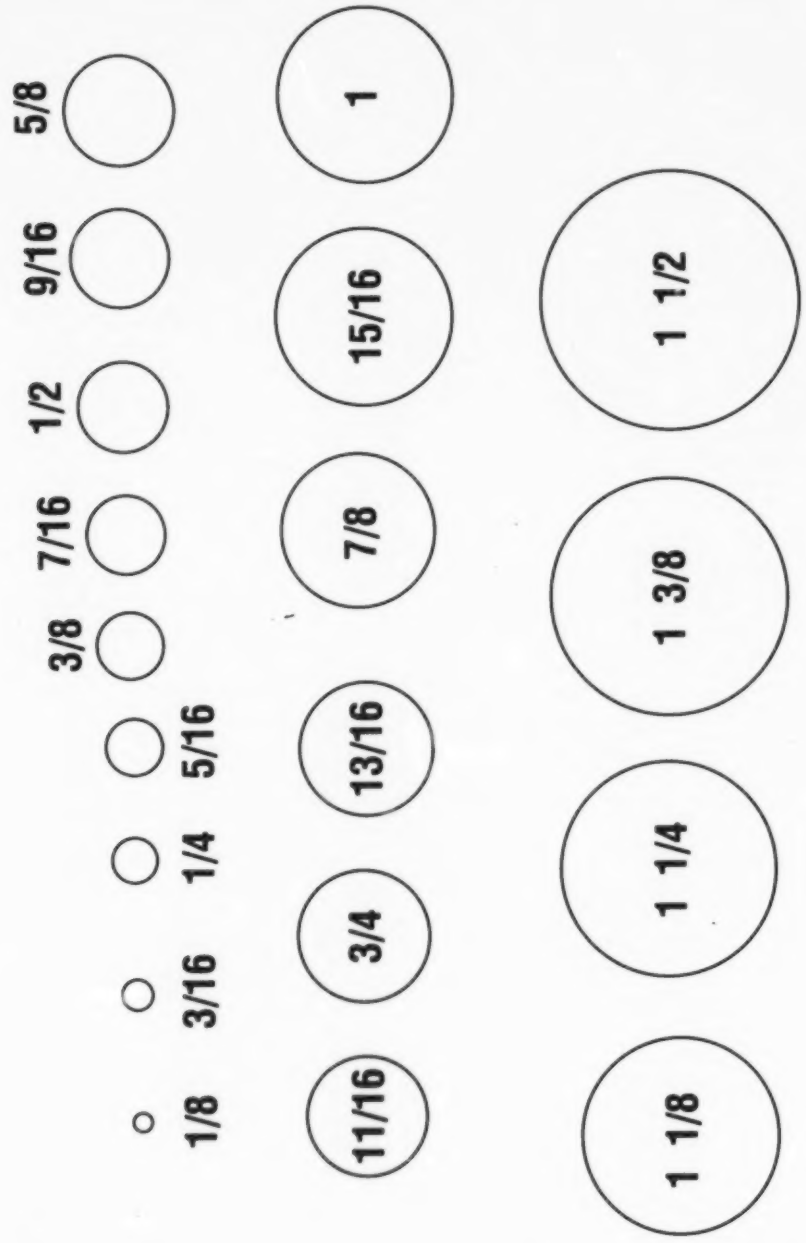
STEP 1: Put the laser in a slightly darkened room and turn it on.

CAUTION
EYE DAMAGE POSSIBLE. Do not stare directly into laser beam.

STEP 2: Tape the piece of paper to the wall where the laser beam strikes.

STEP 3: Estimate the diameter (distance across) of the laser beam on the paper. Write down your estimate on a piece of notebook paper and label it "A."

STEP 4: Hold the Beam Diameter Measurement Sheet (next page) against the wall and move the circles until you find the one that is the same size as the laser beam. Write down the measurement of the circle on the paper used in STEP 3 and label it "B."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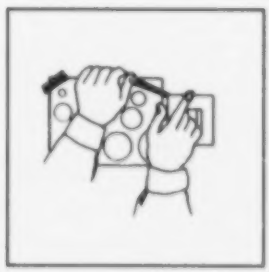
1 1/2

EXPERIMENT 6
(Continued)

FOLLOW THESE STEPS:

STEP 5: On the same piece of paper, subtract your estimate (A) from the actual measurement of the beam (B). Remember to convert fractions (for example, 1/8-inch equals 2/16-inch). How close were you?

STEP 6: Hold the Beam Diameter Measurement Sheet directly in front of the laser and choose the circle that is the same size as the beam as it comes out of the mechanism. Write down the measurement of the circle on the same piece of paper and label it "C." Subtract this measurement from the measurement of the beam on the wall (B) and label it "D." How much did the beam spread out?



STEP 7: TURN OFF THE LASER.

EXPERIMENT 6
(Continued)

FOLLOW THESE STEPS:

STEP 8: Use the tape measure to measure, in inches, the distance from the point where the beam comes out of the laser to the paper taped to the wall. Write down this measurement and label it "E."

APPLICATION

A surveyor would use this to measure distances that are too long to use a tape. For example, say

C = 3/8 inch
D = 1/2 inch
E = 150 inches

We see that it takes 150 inches for the laser beam to spread 1/8-inch. In other words,

D - C = spread per E inches.

So, if the laser beam spread 1 inch, the distance would be 8 x 150 inches, or 1200 inches, or 1000 feet.

EXPERIMENT 6
(Continued)

FOLLOW THESE STEPS:

STEP 8: Use your own figures in the above formula to determine the amount of the laser beam spread. Write the answers to the following questions:

1. Did the laser beam spread more or less than you thought it would?

2. Why is this information valuable to surveyors?

STEP 9: When you finish, clean the work area and return tools and materials to their proper storage areas.

If you complete Day 6 Activities with time left over, you may begin Day 7 Activities.

ACTIVITY REPORT

TECHNOLOGY EDUCATION
LASERS

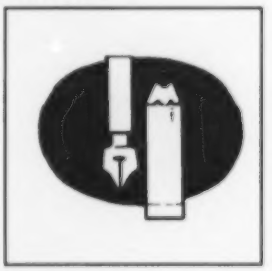
DAY 7 ACTIVITIES

On Day 7 you should complete the following activities:

1. Write a one-page essay on the uses of lasers.

2. Complete the Vocabulary Activity

SUMMARY OF ACTIVITIES



Language Skills:
- Use standard grammar, spelling, punctuation, capitalization

Composition Skills:
- Use complete sentences
- Use topic sentences

TECHNOLOGY EDUCATION
LASERS

DAY 7 ACTIVITIES

OBJECTIVE 5

Write a one-page essay, using correct spelling and grammar, about the uses of lasers.

INTRODUCTION

In this activity you are asked to write a short essay about the different uses of lasers. Write about some uses you learned about in this TLA. Write about other uses you may have already known.

TOOLS AND MATERIALS

- Paper
- Pen or pencil

TECHNOLOGY EDUCATION
LASERS

DAY 7 ACTIVITIES

FOLLOW THESE STEPS:

PROCEDURE

STEP 1: Write a one-page essay describing different uses for lasers. Try to think of some uses that were not discussed in this TLA.

How did lasers change the way some things are done? Have they saved money or time? Have they cost more money or time? What kinds of lasers do you see or use often?

Answer these questions in your essay.

STEP 2: When you finish, clean work area and return tools and materials to their proper storage areas.

IMPORTANT: Continue Day 7 Activities by completing Objective 6.

TECHNOLOGY EDUCATION
LASERS

DAY 7 ACTIVITIES

OBJECTIVE 6

Correctly define (by matching) 10 terms associated with lasers.

INTRODUCTION

In this activity you will read definitions of terms and select the term being defined.

INSTRUCTIONS

You will need a computer scan sheet or card to record your answers to the following questions. Be sure to write your name, the title of the TLA, the date, and the class period on the computer scan sheet or card using a #2 pencil. Use rows 21-30 to record the answers to this activity. If your answers will be hand-scored, use a blank sheet of paper to record your answers and number your answers 21-30.

VOCABULARY ACTIVITY
PART 1

21. The bending of a ray of light when it passes from one medium to another in which its speed is different.

    a) Intensity
    b) Reflection
    c) Refraction
    d) Visibility

22. A three-dimensional picture made by a laser.

    a) Crystalline
    b) Focus
    c) Hologram
    d) Wavelength

VOCABULARY ACTIVITY
PART 2

23. Degree of strength, energy, or force.

    a) Intensity
    b) Polarize
    c) Refraction
    d) Visibility

24. To cause light waves to vibrate in a definite way.

    a) Colloidal
    b) Converge
    c) Focus
    d) Polarize

25. The return of heat, light, or images by a reflecting surface.

    a) Reflection
    b) Refraction
    c) Opaque
    d) Wavelength

26. Not allowing light to pass through.

    a) Fluid
    b) Hologram
    c) Opaque
    d) Polarize

27. The degree of clearness.

    a) Focus
    b) Intensity
    c) Reflection
    d) Visibility

VOCABULARY ACTIVITY
PART 3

28. The distance between the crests of waves.

    a) Converge
    b) Reflection
    c) Refraction
    d) Wavelength

29. Light amplification by stimulated emission of radiation.

    a) Focus
    b) Hologram
    c) Laser
    d) Polarize

30. The spot where light rays come together by the use of mirrors or lenses.

    a) Focus
    b) Hologram
    c) Polarize
    d) Refraction

If you complete Day 7 Activities with time left over, you may begin Day 8 Activities.

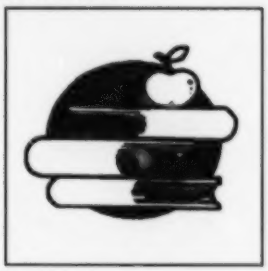
TECHNOLOGY EDUCATION
LASERS

DAY 8 ACTIVITIES

On Day 8 you should complete the following activities:

1. Read Impact Statements
2. Complete Career Search Activity
3. Complete any unfinished assignments.
4. Complete Posttest.
5. Turn in all assignments for the TLA.

SUMMARY OF ACTIVITIES



Reading Comprehension Skills:
- Gain factual information

Functional Reading Skills:
- Follow written instructions
- Use content area vocabulary

TECHNOLOGY EDUCATION
LASERS

DAY 8 ACTIVITIES

ENVIRONMENTAL IMPACT

Lasers have many uses that can help preserve the environment. For instance, lasers can be used to heat fuels such as hydrogen and water for power sources. They can carry voice messages so we don't have to use above-ground or underground wires. And they can be produced with the same amount of energy used for ordinary light, but with much more intensity which saves fuel and cuts down on pollution.

SOCIAL IMPACT

Lasers can be used to heal, to protect, to communicate, all with an efficiency that once would have seemed impossible.

Lasers allow surgeons to reach parts of the body that are inaccessible with the traditional scalpel. Their heat also cauterizes (heat seals) cut blood vessels, which makes stitches unnecessary and speeds healing time.

Lasers are also used in defense and protection systems, either as a means of detecting or destroying danger.

Fiber-optic cables, which use glass fibers to transmit laser light over long distances, allow us to talk to loved ones thousands of miles away.

TECHNOLOGY EDUCATION
LASERS

DAY 8
ACTIVITIES

ECONOMIC IMPACT

The use of the laser-read bar code on products has revolutionized the retail industry. Instead of searching for a price tag and entering the price into the cash register by hand, cashiers can whisk a product over a scanner and the information is instantly sent to the cash register. This saves time and money for the store and therefore the customer. It also helps keep track of inventory, since the information is fed into a computer which can keep a running total of how many items have been sold.

Many credit cards now display a small hologram (3-D image) created by a laser. If someone tries to change the account number or name on a credit card, the hologram is destroyed and the card is useless. This helps prevent counterfeiting, since the equipment needed to create the hologram is not readily available.

TECHNOLOGY EDUCATION
LASERS

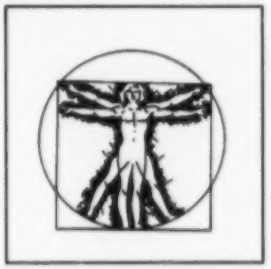
DAY 8 ACTIVITIES

POLITICAL IMPACT

Lasers may some day be used in high-tech weapons, such as the "Star Wars" strategic defense system. Currently they are being used for peaceful purposes. The government has a laser aimed at outer space which is transmitting information about our galaxy. Someone on another planet may eventually receive and decode this information.

ERGONOMIC IMPACT

Lasers are used in many ways to make the world a more comfortable, productive, economical place. They are used to detect flaws in manufactured products, improving quality and safety. And for fun, they also give us compact disc players and laser light shows.



TECHNOLOGY EDUCATION
LASERS

DAY 8
ACTIVITIES

CAREER SEARCH ACTIVITY

INSTRUCTIONS

Using *Career Search Abstracts*, find the occupations listed below. Select the two occupations that sound most appealing to you. On a separate sheet of paper, list the two occupations you selected and tell why. Remember to write using complete sentences, proper grammar, and correct spelling. Give the sheets to your instructor.

RELATED CAREERS

- Laser Technician
- Physician
- Surveyor
- Science Technician

LASER TECHNICIAN

Nature of the Occupation

Laser technicians construct and test prototype laser devices, applying theory and principles of laser engineering and electronics circuits.

Duties may include but are not limited to the following:

- Repairing laser systems
- Performing alignment procedures on optical systems
- Operating laser systems
- Utilizing basic laser and electrical safety practices
- Performing tests and measurements using electronic devices
- Reading and preparing shop drawings and schematics
- Analyzing test data and reporting results

Working Conditions

Laser technicians usually work with engineers, supervisors, managers, and other technicians. They are generally under the direction of a supervisor. Technicians may instruct and supervise skilled workers and other technical personnel.

Laser technicians usually work in clean, well-lighted, and ventilated offices or laboratories. Hazards are a possibility on the job.

Laser technicians usually work a 5-day, 40-hour week. Overtime may be required when an emergency situation occurs. Technicians may be required to travel occasionally to test and service equipment.

Tools, Equipment and Materials used may include:

- Electronic/Optical Instruments
- Circuit Testers
- Switch Panels
- Precision Instruments

Worker Requirements

You should like:

- Working with electronic, electrical, and other types of scientific or technical equipment
- Solving problems relating to processes, machines and techniques

You should be able to:

- Work within set limits and standards
- Visualize objects from drawings or diagrams
- Use good judgment
- Express yourself well orally and in writing

Physically you must:

- Use your arms, hands, and fingers well
- Reach for, handle, and manipulate objects
- See well, either naturally or with correction, including color vision

OCCUPATION SPECIALTIES
DOT CODE:
019.181-010 Laser Technician
SOC CODE: 389

OKLAHOMA CAREER SEARCH

LASER TECHNICIAN

Methods of Entry:
Methods of entering this occupation include direct application to employers. Positions may also be located by consulting school placement offices and state employment offices.

Earnings and Advancement

Earnings depend on the type of firm and its geographical location and the employee's education, ability, and experience.

Earnings:
For salary information, laser technicians are grouped with other science technicians who earned average weekly salaries of $557, in 1990. This is a yearly salary of $28,985.

Fringe Benefits:
Depending on the employer, laser technicians may receive paid vacations and holidays; life, accident, disability, and hospitalization insurance; and retirement plans. These benefits are usually paid for, at least in part, by the employer.

Career Ladder for this Occupation may look like this:
- Supervisor
- Laser Technician
- Trainee

Experienced laser technicians may advance to supervisory positions through a combination of experience, education, and job performance.

Employment and Outlook

The employment outlook for laser technicians will continue to grow as fast as the average for all occupations through the 1990's. At the present time, there are no figures as to the number of laser technicians employed. However, there were 62,000 science technicians employed in 1987. With continued emphasis on laser technology, job opportunities should be good.

Related Education and Training

Level(s) of education and training usually needed for this occupation:
- Technical junior or community college

Level(s) of education and training also available for this occupation:
- College bachelor's degree

School subjects helpful in preparing for this occupation include:
- Algebra
- Blueprint Reading
- Electricity & Electronics
- Geometry
- Cooperative Education-Trade & Industrial

More Sources of Information

- Laser Institute of America
  5151 Monroe Street
  Suite 102W
  Toledo, OH 43623

- State Employment Agencies

PHYSICIAN

Nature of the Occupation

Physicians diagnose and treat human diseases and injuries as well as practice preventive medicine. Physicians may be doctors of allopathic medicine (M.D.) or doctors of osteopathic medicine (D.O.).

Duties may include but are not limited to the following:

- Examining patients
- Ordering or performing various tests, analyses and x-rays
- Prescribing and administering drugs and treatments
- Inoculating and vaccinating patients
- Providing prenatal and postnatal care
- Delivering babies
- Performing surgery and related procedures
- Instructing individuals and organizations in ways to preserve health and prevent disease
- Performing research to aid in control and cure of disease
- Developing and testing new medical techniques
- Investigating new drugs and medications

Occupation Specialties

(Dot codes in parenthesis)

Surgeons (070.101-094) perform operations to correct deformities, repair injuries, prevent diseases, and improve body functions in patients.

Pediatricians (070.101-066) specialize in the diagnosis and treatment of children's diseases from birth through adolescence.

Obstetricians and Gynecologists (070.101-054, 070.101-034) specialize in the care and treatment of women during and immediately following pregnancy and in diseases of the female reproductive organs.

Cardiologists (070.101-014) diagnose and treat diseases of the heart.

Psychiatrists (070.107-014) study, diagnose, and treat mental, emotional, and behavioral disorders.

Podiatrists (079.101-022) diagnose and treat disorders and diseases of the foot and lower leg.

Working Conditions

Physicians may work alone, with other physicians or with the nursing staff. They may supervise interns or residents along with the nursing staff. Physicians generally work in well-lighted and ventilated hospitals, clinics, nursing homes, or offices. They may be exposed to infection from patients, and radioactivity from x-rays.

Hospital or clinical physicians usually work one of three shifts. Private practice physicians generally maintain regular office hours and an emergency answering service.

Physicians may join associations such as the American Medical Association or the American Osteopathic Association. Members pay dues.

Tools, Equipment and Materials used may include:

- Medical Lab Equipment
- X-ray Equipment
- Surgical Equipment, such as Scalpels, Forceps & Clamps
- Stethoscopes
- Electrocardiographs

Worker Requirements

You should like:

- Activities of a scientific and technical nature
- Helping and working with people
- Working with detail

OCCUPATION SPECIALTIES

DOT CODE:

070.101-022	General Practitioner
071.101-010	Osteopathic Physician
070.101-094	Surgeon
070.101-054	Obstetrician
070.101-034	Gynecologist
070.101-066	Pediatrician
070.101-014	Cardiologist
070.107-014	Psychiatrist
079.101-022	Podiatrist

SOC CODE: 261

OKLAHOMA CAREER SEARCH

PHYSICIAN

- Variety, requiring the use of different skills
- Working independently

You should be able to:
- Reason clearly and logically
- Work cooperatively with and direct the activities of others
- Make evaluations and decisions based on judgment and data
- Perceive detail in objects, pictures, or graphs
- Communicate effectively in speech and writing

Physically you must:
- See well, naturally or corrected, with good color vision
- Talk and hear
- Have full use of hands and fingers
- Possess excellent eye, hand, and finger coordination

Special Requirements:

All fifty states, the District of Columbia, and Puerto Rico require physicians to be licensed to practice medicine. Requirements for licensing are graduation from an accredited medical school, internship and passing a state medical exam. Most states grant reciprocity for licensing.

Most states now require physicians to have 150 hours of continuing education credits every three years for license reregistration.

Methods of Entry:

In 1982, 84 percent of all physicians were involved in patient care, with the majority in private practice. Positions with hospitals, clinics, federal and state agencies, and universities may be located by consulting professional journals and medical school placement offices.

Earnings and Advancement

Earnings depend upon whether the physician is salaried or in private practice, the geographic location, higher professional reputation, and length of experience.

Earnings:

Nationally, in 1990, physicians in all categories earned an average salary of about $150,000 per year according to The American Medical Association. Physicians who specialize averaged from about $95,000 to over $200,000 depending upon their specialty, number of years in practice, and skill.

In 1990, physicians who worked for the Veterans Administration earned salaries ranging from $58,796 to $102,268 per year.

Medical school graduates serving as residents in hospitals usually receive full or partial room and board plus allowances ranging from $26,000 to $34,000 per year.

Fringe Benefits:

Depending on the employer, physicians may receive paid vacations and holidays; retirement plans; hospital and life insurance; educational leaves; and sick pay. These benefits are usually paid for, at least in part, by the employer. Most physicians, however, are self-employed and must arrange for their own health insurance and retirement programs.

Career Ladder for this Occupation may look like this:
- Administrator
- Physician
- Intern or Resident

Physicians may advance through experience and professional competence and demonstrated administrative ability.

Employment and Outlook

There were approximately 535,000 physicians employed nationally in 1988. Employment is expected to grow faster than the average as demand for health care continues to outpace overall economic growth. Newly trained physicians are likely to experience competition as they seek to launch a practice. Those who are willing to locate in inner cities, rural areas, and other places where doctors are not in oversupply should have little difficulty.

Physicians held about 5,764 jobs in Oklahoma during 1986. That number is expected to increase to 6,133 by 1992, which represents a 6.41 percent change. Job openings each year for physicians will equal approximately 416, with 354 of those due to replacements and 62 created through new jobs.

Related Education and Training

Level(s) of education and training usually needed for this occupation:
- College Ph.D. or professional degree

School subjects helpful in preparing for this occupation include:
- College Preparatory
- Physiology
- Geometry
- Trigonometry
- Chemistry
- Physics
- Psychology
- English
- Algebra
- Statistics
- Biology
- Physical Science
- Humanities
- Sociology

More Sources of Information

- American Medical Association
  515 North State Street
  Chicago, IL 60610

- American Medical Women's Association
  465 Grand Street
  New York, NY 10002

- American Osteopathic Association
  142 East Ontario Street
  Chicago, IL 60611

SURVEYOR

Nature of the Occupation

Surveyors determine the exact location and measurement of points, lines, and contours of the earth's surface and prepare maps, or reports showing specifications. They use instruments and the principles of geometry to find these exact measurements.

Duties may include but are not limited to the following:

- Studying physical evidence, notes, maps, deeds, or other records
- Checking the accuracy of the information gathered using complex mathematical computations
- Adjusting instruments to maintain accuracy
- Keeping notes and preparing sketches, maps, reports, and legal descriptions of the survey
- Coordinating results with the work of engineering and architectural personnel, clients, and others
- Calculating and adjusting survey data and planning survey systems

Occupation Specialties

(Dot codes in parenthesis)

Geodetic Surveyors (018.167-038) plan, direct, and conduct surveys of large areas of land such as states and counties.

Mine Surveyors (018.167-050) make surface and underground surveys for mine locations, tunnels, subways, and underground storage facilities.

Marine Surveyors (018.167-046) make surveys of harbors, rivers, and other bodies of water to determine shore lines, topography of bottom, or other items to determine navigable channels.

Land Surveyors (018.167-018) establish official land and water boundaries, write descriptions of land for deeds, leases, and other legal documents, and measure construction and mineral sites.

Field-Map Editors (018.262-010) prepare maps using data provided by geodetic surveys, aerial photographs, and satellite data.

Working Conditions

Surveyors work in field crews as helpers, assistants, or chiefs of the survey party. They generally work outdoors except when calculating data, preparing reports, planning new work, or contacting clients.

Surveyors usually work a 5-day, 40-hour week. Sometimes they work longer hours during the summer months when weather conditions are more suitable for surveying.

Surveyors' work is active and sometimes strenuous. They often stand for long periods and walk long distances. They are also exposed to all types of weather conditions.

Surveyors may be required to travel to surveying projects. Living accommodations in field camps or hotels may be provided. They may also be required to furnish their own uniforms or other work-related apparel.

Land surveyors may join organizations such as the American Congress on Surveying and Mapping. Members pay periodic dues.

Tools, Equipment and Materials used may include:

- Tripods & Plumb Bobs
- Theodolites & Transits
- Automatic Levels & Power Telescopes
- Electronic Surveying Instruments
- Field Notebooks & Forms
- Compasses & Angle Prisms
- Leveling & Line Rods
- Steel Measuring Tapes & Reels
- Optical, Laser, Infrared & Microwave
- Hand Calculators & Computers

Worker Requirements

You should like:

- Working outdoors
- Working with your hands
- Performing activities using equipment and processes

You should be able to:

- Work in a team with others
- Solve mathematical problems quickly and accurately
- Follow established rules and specifications to meet set limits, tolerances or standards
- Use logical step-by-step procedures
- Compare and recognize differences in lines or figures
- Keep records neatly and accurately
- Supervise the work of others

Physically you must:

- Maintain good health

OCCUPATION SPECIALTIES

DOT CODE:

018.167-038 Surveyor, Geodetic
018.167-050 Surveyor, Mine
018.167-046 Surveyor, Marine
018.167-018 Surveyor, Land
018.262-010 Field-Map Editor

SOC CODE: 1649

OKLAHOMA CAREER SEARCH

SURVEYOR

- See and hear well, either naturally or with correction
- Possess good eye and hand coordination
- Use your arms and hands fully
- Stand and walk for long periods
- Lift or carry packs of equipment weighing up to 50 pounds

Special Requirements:

All states require land surveyors to be licensed. Departments of licensing and regulation give a 3-day examination. Survey technicians and civil engineers are not required to be licensed except if they do land surveying.

Opportunities for Experience:

Part-time or full-time work as a helper or assistant with survey companies provides helpful experience. All branches of the military service offer opportunities for experience.

Methods of Entry:

Methods of entering this occupation include applying directly to employers and taking civil service exams. Positions may also be located by consulting newspaper want ads, college placement offices, and state employment offices.

Earnings and Advancement

Earnings depend upon the size and location of the employer and the employee's education and experience.

Earnings:

The median annual earnings for survey technicians who worked full time year round in 1990 were about $23,700. The middle 50% earned between $17,800 and $34,500 a year, while the lowest 10% earned less than $14,350 and the highest 10% earned more than $45,200.

Beginning surveyors with little or no training or experience earned about $12,481 at entry-level jobs on survey crews with the Federal Government. Those with one year of related postsecondary training earned $13,619. Those with an associate degree started as instrument assistants at an annual salary of $15,288. The average annual salary for Federal surveying technicians in 1990 was $21,231, for an average weekly pay of $408. Surveyors, aides, and technicians employed by the Federal Government earned $21,231.

The average annual salary in 1990 for land surveyors employed by the Federal Government was $34,867, and for cartographers, $36,821.

Fringe Benefits:

Depending on the employer, surveyors may receive paid vacations and holidays; life, accident, and hospitalization insurance; and pension plans. These benefits are usually paid for, at least in part, by the employer. Surveyors may also receive reimbursement for business-related travel expenses.

Career Ladder for this Occupation may look like this:

- Own Business
- Party Chief or Surveyor
- Surveyor Assistant
- Surveyor Helper

Surveyors may advance through experience and further education.

Employment and Outlook

There were approximately 100,000 surveyors employed nationally in 1988. Employment of surveyors is expected to grow at the average rate through the year 2000 due to increased construction activity. However, employment may fluctuate from year to year because construction activity is highly sensitive to changes in economic conditions. There are, however, indications that demand for surveyors is becoming less dependent on the level of construction activity. Technological innovations that utilize satellites to collect data have opened new areas of specialization.

Surveyors held about 402 jobs in Oklahoma during 1986. That number is expected to increase to 411 by 1992, which represents a 2.50 percent change. Job openings each year for surveyors will equal approximately 13, with 11 of those due to replacements and 2 created through new jobs.

Related Education and Training

Level(s) of education and training needed for this occupation:

- On-the-job training
- Technical junior or community college

Level(s) of education and training also available for this occupation:

- High school diploma or G.E.D.
- College bachelor's degree

School subjects helpful in preparing for this occupation include:

- College Preparatory
- Algebra
- Geometry
- Geography
- Physical Education
- Calculus
- Trigonometry
- Mechanical Drawing

More Sources of Information

- American Congress on Surveying and Mapping
  210 Little Falls Street
  Falls Church, VA 22046

- National Society of Professional Surveyors
  NSPS Coordinator
  5410 Grosvenor Lane
  Suite 100
  Bethesda, MD 20814

- American Society for Photogrammetry and Remote Sensing
  5410 Grosvenor Lane
  Suite 210
  Bethesda, MD 20814-2160

- Federal, State and Local Civil Service Offices

SCIENCE TECHNICIAN

Nature of the Occupation

Science technicians use the principles and theories of science and mathematics to solve problems in research and development, production, oil and gas exploration, sales, and customer service. Their jobs are more limited in scope and more practically oriented than those of scientists. Most specialize in biology, chemistry, agriculture, the nuclear field, or a particular industry such as petroleum.

Duties may include but are not limited to the following:

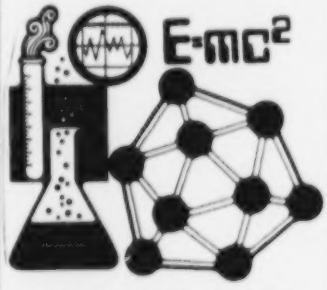
- Building and maintaining experimental equipment
- Setting up and monitoring experiments
- Calculating and recording results
- Helping scientists in research
- Testing products for proportions of ingredients
- Breeding and nutritional work
- Analyzing food, drugs, and blood
- Analyzing air and water for pollution levels
- Manipulating radioactive materials by remote control
- Measuring and recording conditions in oil fields
- Performing activities related to scientific work
- Collecting weather or oceanic information

Occupation Specialties

(Dot codes in parenthesis)

Chemical Laboratory Technicians (022.261-010) assist chemical engineers and chemists in laboratory work.

Assayers (022.281-010) test ores and minerals for values and components, separate, and weigh components.



Laboratory Testers (022.281-018) examine and photograph synthetic fiber samples to assist quality control.

Artificial Breeding Laboratory Technicians (040.361-010) measure the quality of animal semen to improve artificial breeding.

Veterinarian Laboratory Technicians (073.361-010) examine food for purity and use vaccines to prevent animal diseases.

Food Testers (029.361-014) test and report on food for flavor, color, purity, odor, and content quantities.

Biological Aides (049.384-010) assist researchers in agricultural sciences, setting up, testing, record keeping, and cleaning.

Weather Observers (025.267-014) observe weather and visibility using various equipment for pilot briefings or forecasts.

Spectroscopists (011.281-014) examine metals and minerals for density and intensity, and record procedures and results.

Scouts (010.267-010) collect information about oil and gas drilling, geological prospecting, and land or lease contracts.

Working Conditions

Many science technicians work in laboratories and have regular hours. Some may work irregular hours to monitor experiments that cannot be completed during regular hours. Others, such as agricultural and petroleum technicians, do much of their work outdoors, sometimes in remote areas and sometimes in hazardous conditions.

Chemical technicians may work with toxins, nuclear technicians with radiation, and biological technicians with disease-causing organisms. Therefore, safety procedures must be followed.

Many science technicians assist scientists or other professionals. For instance, some examine evidence in criminal investigations; others assist oceanographers, chemists, pilots, veterinarians, and food producers.

Tools, Equipment and Materials used may include:

- Slides
- Microscopes
- Test Tubes
- Beakers
- Crucibles
- Microtomes
- Cameras
- Barometers
- Computers
- Calculators
- Furnaces
- Pipettes
- Scales
- Planimeters
- Thermometers
- Hygrometers

Worker Requirements

You should like:

- Working with things
- Performing scientific and technical work
- Working until a problem is solved

OCCUPATION SPECIALTIES

DOT CODE:

022.281-010	Chemical Laboratory Technician	029.361-014	Food Tester
022.281-010	Assayer	049.384-010	Biological Aide
022.281-018	Laboratory Tester	025.267-014	Weather Observer
040.361-010	Artificial Breeding Laboratory Technician	011.281-014	Spectroscopist
073.361-010	Veterinarian Laboratory Technician	010.267-010	Scout

SOC CODE: 36, 38

OKLAHOMA CAREER SEARCH

SCIENCE TECHNICIAN

You should be able to:
- Perform a variety of duties which may change often
- Evaluate information using measurable standards and personal judgment
- Work within precise limits of accuracy
- Deal with other people

Physically you must:
- Stoop, kneel, crouch, and crawl
- Handle, reach, finger, and feel objects
- See well, naturally or with correction

Opportunities for Experience:
Some companies offer formal or on-the-job training for science technician jobs. Some types of Armed Forces training also provide background for such jobs.

Methods of Entry:
This occupation may be entered by direct application and by taking civil service examinations. Jobs may be found through newspaper want ads, professional journals, college placement offices, and state employment offices.

Earnings:
Science technicians received average salaries of about $23,475 in 1990. The middle 50 percent earned between $17,715 and $31,735. The lowest 10 percent earned under $14,020. The highest, earned $41,299.

In the Federal Government, science technicians had 1990 starting salaries ranging from $13,064 to $16,407, depending on education and experience. The average Federal salary for science technicians in 1990 was $23,535.

Fringe Benefits:
Depending on the employer, science technicians may receive paid vacations and holidays; life, accident, hospitalization, and disability insurance; retirement plans; and sick pay. These benefits are usually paid for, at least in part, by the employer.

Career Ladder for this Occupation may look like this:
- Manager/Technical Sales Manager
- Project Manager/Regional Sales Manager
- Scientist/Technical Sales Worker
- Science Technician

Science technicians may advance by carrying out supervised assignments and demonstrating the capability for independence and initiative.

Employment and Outlook

There were about 232,000 science technicians in 1989. About 40 percent worked in manufacturing, especially in the chemical, petroleum, and food processing industries. Another 40 percent worked in colleges, universities, and independent research and development laboratories. The Federal Government employed about 17,600 science technicians, mostly in the Departments of Defense, Agriculture, Commerce, and the Interior.

Employment is expected to grow at about the same rate as general employment through the year 2000. Biological technicians should find employment more rapidly; whereas, chemical, nuclear, and petroleum technicians should find employment more slowly.

Related Education and Training

Level(s) of education and training usually needed for this occupation:
- Technical junior or community college
- College bachelor's degree

School subjects helpful in preparing for this occupation include:
- General Math
- Algebra
- Geometry
- General Science
- Drafting
- Machine Shop
- Calculus
- Physics
- Electricity & Electronics

More Sources of Information

- American Chemical Society
  Education Division
  Career Services
  1155 16th Street, NW
  Washington, DC 20036

- American Institute of Biological Sciences
  730 11th Street, NW
  Washington, DC 20001

TECHNOLOGY EDUCATION
LASERS

DAY 8 ACTIVITIES

POSTTEST

INSTRUCTIONS

You will need a computer scan sheet or card to record your answers to the following Posttest. Be sure to write your name, the title of the TLA, the date, and the class period on the computer scan sheet or card using a #2 pencil. Use rows 31-40 to record the answers to the Posttest. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 31-40.

SPELLING TEST INSTRUCTIONS

Use rows 41 - 50 on the test card. If the word is spelled correctly, mark (a) on the computer score sheet or card. If the word is spelled incorrectly, mark (b) on the test card. Be sure to use a #2 pencil and make your marks dark. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 41-50.

(a) correct (b) incorrect

Get Posttest Questions from your instructor.

If you complete Day 8 Activities with time left over, you may complete a Skunk Works Activity.

SKUNK WORKS

BACKGROUND

The term *Skunk Works* comes from an engineering division of the 3M Company. In the late 1960s a group of engineers at 3M wanted to design a new product, but the managers of the company would not give them the time or money for research. So they decided to design the product anyway, then try to convince the company to market it. Whenever the engineers could grab a few extra minutes from their regular assignments, they worked on the new product. In early 1969 they presented it to the marketing division of 3M, and the company has been selling it ever since. The product: Velcro fasteners.

CHALLENGE

In Experiment 4 you sent a laser beam through a container of liquid with colloidal particles (sand) and measured the light intensity. In this experiment you will measure light intensity through a gas — air.

TECHNOLOGY EDUCATION LASERS

SKUNK WORKS

TOOLS AND MATERIALS

- Laser
- Table
- Masking tape
- Laser power meter
- Glass container with flat sides
- Small construction paper mask
- Convex lens
- Sand

TECHNOLOGY EDUCATION LASERS

SKUNK WORKS

PROCEDURE

FOLLOW THESE STEPS:

STEP 1: Place a flat-sided glass container on the table in front of the laser.

STEP 2: Aim the beam through the container and tape the small opaque mask on the side of the container where the laser beam comes through. Remember not to look directly into the beam.

STEP 3: Slowly sprinkle sand into the container.

STEP 4: As the sand begins to sink, hold the lens next to the opaque mask and use the power meter to measure the intensity of the light coming through the air.

STEP 5: On a sheet of paper, answer the following questions:

1. Describe what you saw.

2. Why do you think this happened?

STEP 6: When you finish, clean work area and return tools and materials to their proper storage areas.

SKUNK WORKS REPORT